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THE SCOTTISH GEOGRAPHICAL MAGAZINE

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PROFESSOR JAMES GEIKIE, LL.D., D.C.L., F.R.S., HON. EDITOR
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THE SCOTTISH

GEOGRAPHICAL

MAGAZINE.

EXPLORATION AND CLIMBING IN THE NUN KUN HIMALAYA.[1]

By Fanny Bullock Workman, F.R.S.G.S.,
Officier de l'Instruction Publique de France.

(*With Map and Illustrations.*)

The Nun Kun, lying between 33° 55′ and 34° 5′ North latitude, and between 76° and 76° 15′ East longitude, is situated in the Suru province, Eastern Kashmir, south-west of Ladakh and north-west of Zanskar. It forms a part of the middle range of Himalaya, and is a most impressive group of sharp snow and rock mountains twelve miles square, the highest seven peaks of which rise to heights varying from 21,000 feet to over 23,000 feet.

These in turn are flanked on the north and east by several lesser peaks of very abrupt character, whose jagged perpendicular slopes offer insuperable barriers to the approach of the explorer. On the remaining sides many broken glaciers and steep snow walls, while not rendering the main peaks inaccessible, make their reconnaissance and eventual conquest matters of considerable mountaineering experience and preparation.

Sportsmen have occasionally ascended the Shafat valley, the northern approach to the group, to a height of, say, 15,000 feet. Dr. A. Neve of Srinagar, visited this glacier for two days, reaching, he states, a height of about 18,000 feet. A Dutch traveller also made a brief visit to the region, reaching, as he estimated, a somewhat higher point, but ascended no peaks.

Our expedition, therefore, was the first to properly explore the glaciers and to ascend the peaks and passes of the range. Our party was

[1] An address delivered before the Society in Edinburgh on December 12, 1907.

large, consisting of nine Europeans, Dr. Hunter Workman, myself, Cyprian Savoye, guide of Courmayeur, and six Italian porters. I was desirous of trying a new experiment in the Himalaya this season, that of employing porters for carrying all camp impedimenta above where coolies could be persuaded to go willingly, hence the large number of European porters. We had also an English agent, who took up a great quantity of stores and meal to Suru, and procured coolies for us there during the season. He was an ex-police officer from Calcutta, a man well over sixty; but he understood natives, was energetic and strong, and filled the bill. He did not belong to our mountaineering corps, still he crossed a snow-pass of 14,000 feet and slept near the top, which experience would entitle him to membership in most Alpine clubs. Besides three native servants, there were two Gurkhas, loaned us by Colonel Powell, commanding officer of the 1st Gurkha Rifles, who proved useful in conducting coolies to our high camps with supplies.

From Srinagar, Kashmir, to Suru, our first base, is twelve marches. Early in May the agent left with 243 coolies for Suru, by the Wardwan route. Famine having existed in Suru for two previous seasons, little or no rice or grain was obtainable there, so we were obliged to send not only our own tinned goods for the summer ahead, but also 16,000 lbs. of rice for the coolies employed. Two weeks later one of the Gurkhas took another caravan of twenty-five ponies loaded with rice, proceeding over the Leh route, another approach to Suru, and on June 8th we left Srinagar with the guide, porters, and twenty-seven ponies. Besides bringing porters to carry loads in place of coolies, it was agreed that they were to do all their own cooking. In former expeditions we had had frequent complaints from guides that the Kashmir cook, when ordered to kill a sheep for their use, gave them a fiftieth part, keeping the main animal for himself and the other servants. In spite of repeated reproofs from us, it happened again and again, and this season I resolved it should not occur at all. Among the porters, Guide Savoye had selected one who was an excellent cook, so good, indeed, that he was the owner of medals from several Italian cooking societies. They had a servant to assist and make chepatis, but they did all the real cooking, were well fed, and my plan worked perfectly throughout the summer. I will pass over all the preliminary marches, showing only a view of the range from a hill above Suru. With sixty-five coolies we left Suru village in the end of June to follow up the upper Suru or Rangdum valley.

It averages in its upper trend a height of 12,000 feet, and girdles the lower Nun Kun peaks on the north side. Through it rushes the tumultuous unbridged Suru river, which forms a serious barrier in the approach to the massif from the beginning to the end of the summer.

The third march from Suru brings one to a point where the Shafat valley, descending from the Nun Kun, enters the Suru on the opposite side of the river, and here the crossing should be made. But this season, weeks of clear sky and hot sun acting on the glacier above had so swollen the river that the ford here was found impracticable, and we were obliged to make three further long marches, ford, and return two

marches on the other bank, in order to reach the Shafat valley, our objective. Even at the selected fording place the crossing was not effected without difficulty and considerable danger. It took a long time to get our twenty-six sheep and fifteen goats safely over.

There is a monastery inhabited by a bevy of filthy, red-robed lamas near this spot, and one of the lamas, who is also the chief of the adjacent villages, furnished three ponies for those who cared to buffet with the current on pony-back. These native ladies also bade us welcome by presenting us with plates of white flour, for which, of course, a bakshish was expected. Moving backward along the swampy banks of the river, the wild Shafat nala was ascended in two days to the tongue of the Shafat glacier. Here we camped at 13,345 feet a few days, awaiting a caravan of supplies from Suru. This, as well as the upper Suru valley, is devoid of trees. Even at Suru village, 10,850 feet, willow-trees are found only in two or three enclosures, cultivated for grazing purposes. At this camp, and above at Base Camp, the wood of the bushes near the tents was collected and used for fuel. It appeared to be a dwarf willow, and is found on the mountain sides in fair quantity to about 13,500 feet. The still smaller bush called Burtsa, so common in Ladakh, grows here and in Suru, and is collected for winter use by the villagers. Except that they are slightly more fertile, the general character of the Suru valleys resembles those of Ladakh, including the sparse tree-growth.

Here, as well as there, many areas, at heights of 10,000 feet and less, are devoid of trees, which would indicate that the timber line is affected rather by poverty of the soil than by altitude. The Shafat glacier has little purely terminal moraine, being of ice thickly covered with detritus to its end. It is irregular, often rising in high jagged ridges cleft at two or three places by rapidly descending glacial torrents. The tongue shows no evidence of having in recent times projected lower into the valley than it now does, and the glacier appears to be in retreat, having shrunk away from the mountain walls which it formerly reached. Much of the moraine material covering the glacier is coloured red from iron contained in the rocks.

The moraine-covered stretch runs for two miles, where it merges into a firm white ice surface. Near this point many glacial tables, with pedestals of from 3 to 6 feet, were seen. About three miles up, the only west branch glacier enters. It is about two miles long. In the background rises the second highest Nun Kun peak, which later I climbed.

The Shafat glacier now ascends gently for four miles, to where it makes a distinct bend west toward the highest Nun Kun peak. Where this bend occurs a large ice-fall, torn and riven into great séracs, enters from a high snow-valley to the east. This is the only east branch. A view of it was taken above our base camp at about 16,500 feet.

The width here is three-quarters of a mile. We next left the glacier and, clambering over high moraine hillocks, climbed the sharp slants of a border peak to a grass slope, where our base camp for a month, at 15,100 feet, was established.

From here upward the higher trend of the Shafat glacier is seen as it ascends toward the highest Nun Kun Peak. The other two highest summits of the Nun Kun, which lie to the north, are not visible from the glacier, but the avalanche-swept slopes and double summits of a mountain called Z1 by the Indian Survey, over 22,000 feet high, rise from the orographical right bank in icy splendour.

At first view the source of the glacier is apparently to be sought in a col of nearly 17,000 feet at its head, but this is not really the case; the actual contributing forces come from different points, the most important being found on the north-west in the great séracked slopes of the Nun Kun massif, and in those to the south, the tumbled snow-fields of Z1. These, and the immense ice-fall east, furnish the sources of the glacier.

The col, 16,911 feet, we ascended, measured, and named the Fariabad La. It connects the Nun Kun slopes with a lower peak of the Z1 massif, and forms the apex of what our exploration proved to be a pass to the south-west leading to the Fariabad valley. This ridge is the watershed separating the Shafat from the glacier flowing south-west, and offers the only passage in that direction.

While not exceeding nine miles in length, emanating, as it does, from very high abrupt peaks whose mighty snow-slants contribute immense masses to its construction, the glacier is built on an ample scale and composed of powerful members, as evidenced by its ice-falls and long ridges of lateral moraine, which in places turn its banks as high as 16,500 feet into areas of wild chaos. In these respects it may be compared favourably with many of much greater length.

Having made various excursions to the glacier and lower peaks for orientation and measuring, the weather being constantly fine, it was decided to establish camps in the Nun Kun group.

The precipitous icy-looking arêtes of the highest Nun Kun, while much foreshortened from below, did not look propitious for porters to carry tents to its upper slopes, and as the other high peaks were hidden from view by a snow wall and lesser peaks, we decided to move on and see what could be done in the snowy world above. A sufficient reconnaissance having been made by Guide Savoye, the plan was to send porters a few days ahead to deposit food and tents at convenient intervals. Coolies were to accompany them to the first snow-camp near rocks, and, if possible, to one still higher. After leaving the coolies the porters were to go up further alone, make a cache of tents, and return to meet us.

Some of our Suru coolies proved much sturdier and better disposed men than the Baltis, with whom we have had considerable experience in previous expeditions. The advance party being well in front we left Base Camp on July 25th with the guide, two porters, and fifteen coolies, ascending over moraine ridges for an hour to snow. On the long slopes traversed we came upon large stretches of "Nieves Penitentes," never met with by us before in four seasons of Himalaya exploration. They usually ran in parallel lines, their cowls or crests turned away from the prevailing wind. Going toward them one seemed to approach a sea of crested snow-waves shimmering in the sunlight.

From every point where I studied them, the impression of the snow being first massed into ridges by the action of the wind grew stronger. Those who have observed them in the Andes differ, I know, in opinion as to the importance of wind as an agent in their formation. In the Himalaya it appears to play a considerable rôle. That the sun's rays are instrumental in modelling the snow thus blown together into the forms they finally assume, and in shaping their crests, also seems probable.

Did the Nieve Penitente occur in Baltistan, where I have never seen it, the sun's action might be considered of less importance, as the climate is an essentially rainy one, but the Suru climate, much like that of Ladakh, is subject to hot sun and strong wind. I noted four weeks when the sun shone daily with intensity for eight hours, while the prevalent west wind also set in each day at a certain time, blowing strongly for as many hours. Sun and wind are the most potent factors in the Suru climate, and their influence, as evidenced in many ways above the snow-line, is very great.

The surface between the Nieves was corrugated, making them appear as if connected by ice wavelets. A German authority, who rejects the idea of wind agency, lays special stress on the fact that in the Andes the Nieves occur usually in wind-sheltered places. In Suru this is very far from the case. We saw them in various wind-exposed spots ; in fact, the summits of two peaks we ascended were completely covered with good-sized ones, and one peak, height 20,571 feet, had a sharp, very exposed apex of rock, while the other side, a snow-slant, was strewn over with these icy needles.

While showing in general the same characteristics as those of the Andes, the Himalayan Nieve, as seen by us, was much smaller, varying in height from 8 inches to 3 feet.

Before this digression on the Nieves, we were ascending to the first snow-camp, which was at 17,657 feet and named Nieves Penitentes Camp. Wood had been brought up, there being rocks near by where the coolies could light fires and cook their food. I would here say that all our heights, except on one or two occasions when weather interfered, are calculated from hypsometric readings compared with simultaneous ones taken at a lower Government fixed station at Dras, 35 miles distant, three times daily for us during the summer. We also had three of the latest aneroids, graduated to 25,000 feet, which were daily checked by the boiling-point. It was not cold here at night, the minimum temperature being 17° F.

Our route the next day lay at first over a sharp snow-wall, and then came long ascending côtes, broken here and again by high icicled schrunds. For a time the ascent became easier, and our caravan marched over a gentle slope. The scenery became hourly more impressive as the beautiful ranges toward Zanshar to the East unfolded themselves in ever changing light and shade. Thus far nothing had been seen of our advance porters, but after ascending some steep slants we suddenly perceived them descending a slope in the distance.

Soon two tiny tents, on the spot for our night's halt, were seen high up on a snow-slope, and slowly we approached it, for we were at a good

height and all stopped often to relieve their lungs. The position of this camp (White Needle Camp) was striking, being on a slant of névé at the foot of a wild ice-fall and bounded 200 feet below the tents by a yawning bergschrund.

The icy grandeur of the scenery was too beautiful for words, and we were never tired of gazing upon the wonderful Z1, the dominant mountain of that ice world.

Most of the coolies were now ill, and all but two volunteers and a tent servant were sent back. This camp was at 19,900 feet, 550 feet higher than our highest camp in Baltistan, and we expected a trying night, for, as every one knows, one suffers most from diminished atmosphere when in lying position. In this we were not disappointed, for not one of the nine Europeans got more than a few snatches of sleep during the long dark hours. The minimum temperature was no lower than at the previous camp, 17° F., which was odd, for when we camped here on the return it was 10° F.

The following day's climb was not to be long, but it was very trying, for we had almost at once to attack the high snow-wall rising at inclines of from 50 to 60 degrees. The guide and porters carried loads of 40 lbs. We went nearly straight for a time, and the calls for short halts from those loaded were frequent. Later we made an aerial pathway across the wall, which was really of ice, covered only by a layer of snow. I am not here to describe in detail the mountaineering aspects of the ascent, but to give you an idea of the massif.

The wall finally ended in gently rising slopes, and, as we continued over these north-west, the grand Nun Kun panorama was slowly revealed. First a long plateau or great elevated basin, afterwards estimated at 3 by 1½ miles, stretched in untrodden whiteness in front. This was a great surprise, it not being indicated on any previously existing map. It descends for a time below the icy arêtes of the highest Nun Kun, then slowly ascends from 20,400 feet to 21,600 feet to the bases of the six other impressive peaks which encircle it in a tiara of great beauty. Soon the refuge ahead came in sight, three small tents planted in the snow the day before by the porters. Soon after arrival clouds covered all, and it snowed and cleared intermittently for some hours.

The three natives were sent back from here to Nieves Penitentes Camp with orders to hold themselves in readiness to hurry to Base Camp for more coolies when word should be brought by a porter. We were now well cut off from communication with the world of grass below. One Italian porter was here attacked with severe altitude symptoms, and the next day gave out altogether, leaving only six men for carrying loads. The height of this camp (Camp Italia) is 20,632 feet.

There are three cols in the massif. There are also four glacial outlets to this high basin, one north-west carrying the snows to the Rangdum valley, three south, two of which drain to the Fariabad and one to the Shafat glacier. When the weather cleared, we studied carefully the highest Nun Kun, lying behind the camp (see Fig. 1) and seen to its apex, 2800 feet above. The last 1000 feet might be climbable, but

one, possibly two camps would have to be established, and the 1700 feet of sharp arêtes rising at a great incline were deemed impossible for men carrying loads. One fact we proved sufficiently this season, namely, that for porters to carry loads above 21,500 feet slopes must be fairly moderate, not over 35 or 40 degrees.

So our next move was to be toward the second summit, lower by 140 feet, but easier of approach, at least for our loaded assistants. Soon after sunset we took to our sleeping-bags, and the next ten hours passed slowly, for no one slept. The minimum temperature for the night was 4° F. I will add that three of the party suffered from

Fig. 1.—Camp Italia, 20,632 feet, and Nun Kun plateau.

severe pain in the back, chest, and limbs, also from migraine, but were in no way incapacitated by the symptoms.

It had been decided to leave the guides' and porters' tents behind, as they were to accompany us to a higher camp and return for them the same day, so on the following morning, as soon as our frozen tents could be pulled up, we left, descending about 200 feet, then ascending over the gradually rising plateau. The sick porter started out, but soon had to return to Camp Italia.

By the time the base of the Nun Kun cirque was reached clouds came in, and it snowed a little, as on the previous day. The snow under-foot was very bad, and it now seemed doubtful if the guide and porter could return that night to us. Go down they must, so, after our tents were

pitched, it was agreed that if the snow allowed they would return, if not, we were to remain there alone, and those allotted to go higher would rejoin us early the next morning.

I fancy it will not be deemed Chauvinistic if two Americans, camping alone at 21,300 feet, the highest properly measured camp yet made by mountaineers, called their icy night's refuge Camp America. I am well aware that two climbers claim to have bivouacked in the open at 22,000 feet and 23,000 feet for a night, but they make no pretence to having done more than roughly estimate these heights, whereas ours was carefully measured by the method before spoken of, and is, I believe, the highest authentic camp yet made, and the highest measured point at which mountaineers have passed a night.

I will briefly mention a few temperatures taken here. In the afternoon the sun shone through a mist, and we suffered greatly from heat, which both in and without the tent was almost unbearable. At 2.30 the sun temperature noted with solar thermometer was 193° F., and at 3.30 was 142° F. At 7.30 P.M. we had 22 degrees of frost. At 9 P.M. it was about zero, and the minimum for the night was −4° F. Thus in fifteen hours we were subjected to variations in temperature of 197° F.

After sunset, the weather having completely cleared, we took a view of the highest Nun Kun peak rising in solemn majesty in the weird crepuscular light. The night seemed the longest and was the coldest I ever passed, and no sleep came to break the monotony of the dragging hours.

About daybreak Savoye and two porters arrived with red swollen faces and moustaches fringed with icicles. As soon as it was possible to pull on our hard frozen boots we started upward (Fig. 2).

It must be remembered that none of us had slept for three nights, but strength came with climbing even at 22,000 feet, and soon our nerves at least responded to exercise and the benign rays of the sun. I must pass over details of the ascent, simply remarking that it was over very sharp slants, broken by gruesome bergschrunds and dangerous ice-falls for some hours. Our position on the slants was so precarious that photography was difficult, and few views were secured.

This is the third Nun Kun peak in point of height triangulated by the Indian Survey at 23,264 feet. I have been told by a former Surveyor-General, himself an expert topographer, that the parties working do not necessarily attempt to fix the highest peaks, but rather those occupying the most prominent position in relation to the trigonometrical station. This and the highest Nun Kun were the salient landmarks seen from the neighbouring trigonometrical stations, whereas the peak I climbed lying behind the others, and only its top seen as a sharp aiguille, might not attract especial attention. The Survey map gives little idea of the true conformation of the different features of the Nun Kun massif. That my peak is the second highest of the range there can be no question, for not only was this conceded to be the case by all members of the expedition who studied it from several points, but a much more conclusive evidence may be cited. On levelling off just

below the top of my peak on the former, its summit was found to be a good bit lower than where we stood. The difference as the level made it was about 50 feet.

We stopped often to recover breath, but no real halt was made until 22,720 feet, where Dr. Workman, as the weather showed increasing cloudiness, stopped with one porter to photograph. The snow-slope, which was ascended to this point, has about the same gradient to the base.

After some tea and plasmon chocolate I continued the ascent, which

FIG. 2.—Pinnacle Peak, Nun Kun, 23,300 feet. First ascent by Mrs. Bullock Workman and guides.

was very sharp. We climbed sometimes over snow, but mostly upon rock, and the difficulty of breathing now became extreme. I had not supposed I could handle such steep work at that height, for my highest climb in 1903 was at a moderate incline near the top, but somehow it was managed, if but slowly.

When I halted every ten steps, the others seemed quite ready to rest their hard-taxed lungs also. At last we stopped, our task finished, and the world for many miles lay at our feet.

The view was not so impressive as some I have seen from high Asiatic mountains, because, with the exception of the highest Nun Kun, now cloud-bound, we overlooked everything. Directly beneath, on one side, the great slopes we had ascended plunged down to the Nun Kun

plateau, a sheet of driven snow, while on the other a perpendicular precipice fell some thousands of feet into a savage, rock-bound abyss, containing the lower west branch of the Shafat glacier.

An icy wind blew, and I had my hands full with the instruments. The least exertion also caused painful gasping for breath. We were at 23,000 feet, which was a compensation for much discomfort. The corrected reading of the aneroid was 13 inches, which, compared with a simultaneous reading at the lower measured Government station at Dras, 34 miles distant, gives 23,253 feet. As I remarked before, this appeared on levelling off to be about 53 feet higher than the summit triangulated at 23,264, so that the height assigned to it of 23,300 feet may be called approximately correct.

It was 2 P.M., and camp could hardly be made before 7.30, so descend we must from our high vantage-point. By this ascent of over 23,000 feet I not only broke my last woman's mountaineering record of 22,568 feet, but am to be included, I believe, in the small band of mountaineers who have climbed to 23,000 feet and over.

On the way down we climbed a sharp pointed rock, where Dr. Workman photographed us at something over 23,000 feet above sea-level.

Rejoining the others, the further descent to camp was safely accomplished at 7 P.M. The minimum temperature was 2 degrees lower that night at Camp America : -6° F. As soon as the porters arrived in the morning, we packed tents and returned to Camp Italia. There we had breakfast, and I took a snapshot of the party drinking their coffee. From there the descent to Base Camp was made in two days.

You will recall my having spoken of the Fariabad La, near the head of the Shafat glacier. We wished to force a passage over it with the main caravan to the south of the range. After a previous reconnaissance with guide and porters, we successfully carried out the crossing with servants and fifty coolies.

The difficulties, which were great for the first two days, were bravely overcome by our sturdy Suru men and the head of the Fariabad nala reached. The ice-stream descended in reaching this valley is four miles long. We named it the Fariabad glacier. From here a valley running north-west, still encircling the Nun Kun, was ascended, and another glacier and new snow-col climbed. Into this valley the tongues of four glaciers entered, the second of which was noteworthy, being different from any we had before seen in Himalaya, in that it had formed a terminal moraine composed of large hillocks of fine brown sand.

The new col, 17,397 feet, which we reached one day three hours in advance of the caravan, was called the North-West Pass. Here the prismatic compass was brought into use, for this was new ground and at first sight it was not clear which way we ought to move. Looking north 38° West, long snow-fields were seen descending and later ascending to an arête connecting two rock and snow peaks, and this being the right direction, we struck out for it. A dense fog soon shut out all landmarks, but having taken bearings before we kept on and in an hour and a half, when the mist lifted, found ourselves just under the rocky col.

Climbing to it we decided to camp on the narrow rock-ridge. (*Barmal Camp.*) The glacier here is not indicated at all on the Survey map.

It is over a mile wide, its broad, nearly smooth surface resembling a large snow-lake, and it descends eight miles, ending in green slopes to the west. Dr. A. Neve in crossing to the Bara Zajnai valley a few years ago saw the glacier, and he states that it descends directly from the highest Nun Kun peak. He is here mistaken. It finds its source in a snow basin, enclosed on the north by peak D41, on the south by

Fig. 3.—Summit of Mount Nieves Penitentes, 19,080 feet, D41 in background.

Nieves Penitentes Peak, and on the east by a jagged rock arête connecting the two. The Nun Kun peaks are further to the east, and their snow-fields are cut off from this glacier by the two peaks and high wall mentioned. As we ascended both of the peaks we had excellent opportunity for studying the true topography of the region. We named the glacier Barmal glacier.

Both of these mountains were ascended from the Barmal Camp, where we stayed three days. The first one, a wild-looking affair of sheer snow and rock walls, rose just above camp. Its slopes, most of which towered at an angle of 70°, offered enough step-cutting to satisfy even the unflagging energy of Savoye. Part of the route lay straight up icy arêtes.

Arriving at what had appeared from below to be the summit, we

saw another higher one just ahead, accessible by a sharp ridge covered with Nieves Penitentes. On reaching this, still a third top somewhat higher was discovered. On we climbed to that, where we were completely surrounded by Nieves Penitentes. This peak, 19,080 feet high, had given us a stiff but exhilarating climb. We named it Mount Nieves Penitentes. We saw in the background peak D41, and we decided to attempt its ascent the next day. The view from the peak we were on was magnificent. We saw the snowy sheet of the Barmal glacier, while the Zanskar ranges and the great Z1 and its glaciers towered to the south-east, and the forbidding ice and rock precipices of the Nun Kun loomed north of east.

We left at daybreak the next morning for D41, as the climb was likely to be rather long, and the weather on this side of the range was uncertain, fog usually setting in after twelve and covering the mountains for some hours. I shall not describe the ascent in any detail, for you must be tired of such description by this time, but it was a grand climb from the mountaineer's point of view, and topographically most interesting.

We had first to descend to the Barmal glacier, then cross it before attacking the lower snow-fields here seen. I had in climbing this mountain the first and only attack of mountain sickness of the summer. I began to have severe headache and nausea on the glacier, and these symptoms continued all the way to the top, so that only sheer force of will ever brought me to the sharp pinnacle seen on the sky-line. I speak of it as showing what an evasive, independable thing mountain sickness is. Here I had symptoms of it, and at two and three thousand feet higher I had had none. The pyramid top of this peak is peppered over with Nieves Penitentes, so you see that in the Nun Kun we found them at a great height and in a very exposed place. The snow suddenly ends at an overhanging rock-cornice at the top.

The height is 20,571 feet. While equally fine, the view was quite different from that seen from the other peak. Standing on the rock-cornice we were literally perched over thousands of feet of space, below which the Barmal glacier sank in radiant snowy curves. The route towards the valleys could also be traced over the Sentik Pass, down miles of glaciers and moraines succeeded by lines of green spurs, culminating in the distant vale of Suru 10,000 feet below.

We had supposed we were the first visitors to this summit, but in this we were mistaken, for just below the ledge we were on, a solitary mountain chough sank gracefully into the great void, flying at over 20,000 feet. Our observations and photographs were hardly complete when the noon curtain of mist swept in, covering the peak and our route of descent.

We beat a hurried retreat in two caravans. Mine in front was at once lost to view of the second. There was no denying the danger, but descend we must, for there was no means of knowing when the fog would lift. We groped along hour after hour searching for the old tracks, down icy slants, along weird-looking arêtes, jumping crevasses we scarcely saw the width of through the white pall. We seemed to wind

around and over the roof of the world of desolation. It snowed at times, but the worst feature was an icy wind that chilled to the bone, blowing the fog into a white fringe on our coats.

After unceasing effort the steep upper half of the descent was safely made, and as the mist passed off for a time we sat down to rest and reflect upon what a dire, horrible object of foreboding a grand Himalayan peak can become under adverse circumstances. Later camp was reached after a thrilling first ascent of D41.

After this we crossed the Barmal glacier and Sentik pass and returned to Suru a few days later, having successfully carried out the first circuit of the Nun Kun range, a distance of 90 miles, 40 of which led over glaciers and new snow cols.

If you will spare me still a few minutes, I would like to speak of one or two matters. First, my experiment of taking porters out to carry loads above where coolies can be forced, proved successful. The guide and porters carried loads of 35 to 40 lbs. for four days, some even for six, at altitudes of 19,900 feet to 21,300 feet and stood the test well. It may be noted, however, that the slopes from the third to the fourth camp, that is after 20,600 feet, were gentle.

Whether Europeans can carry above 21,500 feet on sharp slopes has yet to be proved, but on moderate inclines above that height some would doubtless succeed while others would give out. Which would be the men to stand the strain could not be determined in advance, for the strongest man under ordinary circumstances is not always the most enduring at a great height.

I will next mention the altitude symptoms affecting some of our people. After 20,000 feet four of the party had headache and pain in the back, chest, and limbs. Three also above that height had coughs, which disappeared on regaining 15,000 feet. As I was one of the victims to the latter malady, I would add that I not only coughed, but suffered from a cold in the head most of the time after 19,000 feet in this region, symptoms I never had at like altitudes in Baltistan. Some years ago I was likewise affected in Ladakh above 17,000 feet, and it is possible that the much drier climate of Suru, resembling that of Ladakh, was accountable for these peculiar symptoms.

From mountain sickness, which in the accepted sense means great bodily debility, unbearable migrane, and severe nausea, only one of the nine Europeans suffered. No one had hæmorrhage of the nose or ears. I speak of this, as Dr. Cook mentions that some of his party were subject to this trouble on the ascent of Mount M'Kinley. We were always able to carry out our daily task, although subject to what may be termed mountain lassitude above 20,000 feet. The body is certainly not in its normal state above that height, and most persons experience loss of appetite and insomnia. I noted these symptoms rather increased than diminished the longer we remained very high; therefore I do not believe in acclimatisation at or above 21,000 feet.

Cold also may become a very deterrent obstacle to a person not feeling wholly fit, and its grip upon the vital forces of a man who is really mountain sick is curious. The porter who got ill at our third

snow-camp had made a winter ascent of Mount Blanc from Courmayeur the year before in a temperature below zero and had not suffered from cold nor altitude; whereas in Himalaya at 20,600 feet he lost all feeling in his hands while moving in the sun at 9 A.M., and had to be massaged by the guide for some time before he could return to his tent.

But I would lay special stress on insomnia, from which we all suffered. Two, four, perhaps six sleepless nights and the human frame must become weakened and unfit for severe physical work. Therefore I believe that when the highest peaks of 28,000 and 29,000 feet are seriously attacked, more will fail through sleeplessness and its effects than from any other cause. Deficiency of oxygen is of course the primary factor, as it produces in a large measure the inability to sleep, but I would designate insomnia as the real mother of altitude symptoms and more to be dreaded on Everest than mere mountain sickness.

During our five summers of Himalayan exploration we have made a point of noting high sun temperatures. The last season for observing sun temperatures on snow was not so noteworthy as the former one passed in Baltistan, for the reason that clouds obscured the sun at the noon hours at most of our high camps, the highest sun temperature on snow being, as before stated, 193° F. at 21,300 feet.

On the other hand, at lesser heights in the valleys higher sun temperatures than in Baltistan were observed, three of which I will cite. On June 28th at Suru, 10,850 feet, the sun temperature at 1 P.M. was 206° F.; shade reading 74° F. On August 18th, at the same place, 1 P.M., a sun reading of 216° F., shade 71° F., was taken; and August 19th, the highest sun temperature we have ever had was noted, namely, 219° F., shade 72° F

NEAREST THE POLE: A REVIEW.[1]

THE members of the Royal Scottish Geographical Society, who were privileged to hear Commander Peary's brilliant address to the Society on 12th November 1903, will know what to expect in the handsomely got up and beautifully illustrated volume in which he describes his latest effort to reach the Pole. Of late years there have been so many Arctic expeditions that we might fairly expect that public interest in the subject would diminish, but it speaks well both for the public and for the devoted and courageous men who, undaunted by previous failures, renew the battle with the Polar Storm King, that public interest in their exploits, so far from being diminished, waxes greater and greater, and there is a general consensus of belief that the feat of reaching the Pole will be achieved within a few years. As it is, we now know that on the 21st April 1906, Commander Peary arrived within 174 miles of the Pole; and his failure to reach the goal of his ambition

[1] *Nearest the Pole.* By R. E. Peary, U.S.N. London: Hutchinson and Co., 1907. *Price 21s. net.*

was caused by no fault of his own, no slackness of effort, no want of energy, not even by error of calculation, but solely by climatic conditions, with which he and his brave comrades might and did contend, but could not possibly overcome. We have had of late, as we have already remarked, many narratives of Arctic adventures and prowess, but we have no hesitation in saying that this, the latest of the series, is second to none in thrilling personal interest or in the importance of its scientific results. It is, as our readers should know, some twenty years since Commander Peary first turned his attention to the quest of the North Pole, and it was in no spirit of bravado, but rather with the calm, fixed determination of the man who knows the grave import of what he says, and has counted the cost, that when he received the Hubbard medal of the National Geographical Society, he said: "To me the final and complete solution of the Polar mystery, which has engaged the best thought and interest of some of the best men of the most vigorous and enlightened nations of the world for more than three centuries, and to-day quickens the pulse of every man or woman whose veins hold red blood, is the thing which should be done for the honour and credit of this country, the thing which it is intended that I should do, and the thing that I must do." From every class of community in the civilised world there will be one cordial and sincere hope that Commander Peary may soon achieve his arduous task, and realise his long-deferred ambition of planting the American banner, which he loves and serves so well, on the spot on which he has set his heart.

In one respect he has been fortunate, *i.e.* he has been and is ably and cordially supported by the Peary Arctic Club of New York. This now celebrated club came into existence only eight years ago, and its *raison d'être* is to promote Arctic exploration on the lines suggested by Peary's experience. In the volume now before us we have a succinct and interesting account of what it has done to justify its existence, and also a report *in extenso* by Commander Peary of the work done in the Arctic regions in the years 1898 to 1902. Our readers will remember that it was on the work done during that period that he addressed this Society in 1903. But of course the main interest of the volume now before us lies in the story of the expedition which left New York in the *Roosevelt* on 16th July 1905.

Most judiciously a special chapter has been devoted to a detailed description of the *Roosevelt*, on the efficiency of which so much depended, and it is interesting to find that it was constructed on a Scottish model rather than on the models of other countries. This chapter will certainly be carefully studied by all who have hereafter to do with the construction of ships for Arctic or Antarctic exploration. Commander Peary himself, after ample experience, pronounces the *Roosevelt* the ablest ship ever built for Arctic exploration. Its crew consisted of twenty men, six of them from the United States, and the remainder from Newfoundland. On her way to Cape York and Etah, the *Roosevelt* encountered a good deal of fog, but on the whole the weather was propitious. Between Cape York and Etah, a station on the southern point of Kane Basin, the *Roosevelt* and the *Eric*, an auxiliary steam whaler,

collected together the Eskimo who were to accompany the expedition, also two hundred dogs, and some tons of walrus meat. Soon after leaving Etah, on the 16th August, the *Roosevelt* was to meet its "baptism of fire" in the shape of heavy pack-ice surging down Smith Sound. From this time on till 5th September, when she reached her winter quarters at Cape Sheridan, the *Roosevelt* had to contend with all the dangers and difficulties of Arctic navigation with which we are now familiar. But she proved herself quite equal to the task, and we can understand and appreciate the eulogium passed by Commander Peary on his ship when we read such passages as the following: "The *Roosevelt* fought like a gladiator, turning, twisting, straining with all her force, smashing her full weight against the heavy floes whenever we could get room for a rush, and rearing upon them like a steeplechaser taking a fence. Ah, the thrill and tension of it, the lust for battle, which crowded days of ordinary life into one! The forward rush, the gathering speed and momentum, the crash, the upward heave, the grating snarl of the ice as the steel-shod stern split it as a mason's hammer splits granite, or trod it under, or sent it right and left in whirling fragments, followed by the violent roll, the backward rebound, and then the gathering for another rush, were glorious."

The autumn and winter, which lasted till 7th February 1906, were spent in hunting for food and in making preparations for the sledge expeditions of the next season. In perusing other narratives of Arctic explorations, we have met and sympathised with doleful descriptions of the dreary monotony of the Arctic winter; such sympathy apparently is not needed for the cheery explorers at Cape Sheridan in 1906, of whom the chief says: "The usual monotony of the Arctic winter was entirely destroyed for us (outside of the continuous excitement which the movement of the ice afforded us) by the extensive widening of our horizon as a result of my settlements in the interior. . . . Personally I have never spent a winter in the Arctic regions so free from petty annoyances and discomforts, both physical and mental. The members of the party were congenial, cheerful, energetic, and interested in the work. The ship's people were interested and willing, and the atmosphere of the ship lacked entirely the element of friction which is so often an extremely disagreeable feature of Arctic winter life."

The only anxiety he had was about the efficiency of the dogs, among whom an unaccountable and disastrous mortality had occurred, which reduced their number from two hundred to one hundred and twenty. At length on the 19th February the first move was made to Cape Hecla, where in due course a party of seven Americans and twenty-one Eskimo assembled to begin the great task. The first party under Henson left on the 28th February, Bartlett followed on the 1st March, and the others in due course, Peary remaining last so as to put things right at Hecla. Leaving Hecla on the 5th March, he marched to Point Moss some twenty miles off, and then started due north in the hope of reaching the Pole. At first they had tolerably good weather, but on the 22nd March further progress for the time was impossible owing to a fierce west wind. Pushing on as opportunity and weather permitted,

the explorers found themselves pulled up at Lat. 84° 38′ by a lead of open water stretching east and west further than they could see. Here they lost seven invaluable days of fine weather ere they could get across on the 2nd April.

After this, continuous stormy weather made it very difficult to keep the trail, and marching against wind and snow was extremely trying and exhausting. The dogs gave out one by one and were eaten. At last on the 21st April, in Lat. 87° 6′, or 174 nautical miles from the Pole, it was clear to Commander Peary that his party could go no farther. We quote his own account of his sensations at the time. "I should have liked to leave everything at this camp and push on for the one march with one empty sledge and one or two companions, but I did not dare to do this owing to the condition of the ice, and was glad as we advanced that I had not attempted it. I do not know if any of my Eskimos would have remained behind. In this last spurt we crossed fourteen cracks and narrow leads, which almost without exception were in motion. When my observations were taken and rapidly figured they showed that we had reached 87° 6′ North latitude, and had at last beaten the record, for which I thanked God with as good a grace as possible, though I felt that the mere beating of the record was but an empty bauble compared with the splendid jewel on which I had set my heart for years, and for which on this expedition I had almost literally been straining my life out. . . . As can perhaps be imagined, I was more than anxious to keep on, but as I looked at the drawn faces of my comrades, at the skeleton figures of my few remaining dogs, at my nearly empty sledges, and remembered the drifting ice over which we had come, and the unknown quantity of the 'big lead' between us and the nearest land, I felt I had cut the margin as narrow as could reasonably be expected. I told my men we should turn back from here."

The march back to the Greenland coast was as adventurous and trying as anything they had hitherto experienced. The bad weather had to a great extent obliterated the trail, and it was with the greatest difficulty they made their way back to Storm Camp, from which Commander Peary decided to make a "bee-line" for the coast, where he expected to find musk oxen. On their way back they were again pulled up by the same wide lead of open water, which on the outward journey they had called the "Hudson," but now they named it the "Styx." After days of anxiety as to how they were to get across, the Eskimo reported that a film of young ice had formed across the lead at some distance off, and it was decided to attempt to cross it on snow-shoes. We quote Commander Peary's graphic description of the dangerous crossing. "I gave the word to put on snow-shoes and make the attempt. I tied mine on more carefully than I had ever done before. I think every other man did the same, for we felt that a slip or a stumble would be fatal. We had already tested the ice and knew it would not support us for an instant without snow-shoes. When we started it was with Panikpah, lightest of us all and most experienced, in the lead, the few remaining dogs attached to the long broad-runner sledge following him, and the rest of the party abreast in widely extended skirmishing line,

fifty to sixty feet between each two men some distance behind the sledge. We crossed in silence, each man busy with his thoughts and intent upon his snow-shoes. Frankly, I do not care for more similar experiences. Once started, we could not stop, we could not lift our snow-shoes. It was a matter of constantly and smoothly gliding one past the other with utmost care and evenness of pressure, and from every man as he slid a snow-shoe forward, undulations went out in every direction through the thin film incrusting the black water. The sledge was preceded and followed by a broad swell. It was the first and only time in all my Arctic work that I felt doubtful as to the outcome, but when near the middle of the lead the toe of my rear kamik as I slid forward from it broke through twice in succession, I thought to myself 'This is the finish,' and when a little later there was a cry from some one in the line, the words sprang from me of themselves, 'God help him, which one is it?' but I dared not take my eyes from the steady even gliding of my snow-shoes and the fascination of the glassy swell at the toes of them. When we stepped upon the firm ice on the southern side of the lead, the sighs of relief from the two men nearest me on either side were distinctly audible. I was more than glad myself."

After some terribly exhausting marches the weary explorers were cheered by the sight of the Greenland mountains, and they made for Cape Neumeyer, on reaching which they regaled themselves with the unwonted dainty of raw hares. But ere they reached Cape Neumeyer they had the great good fortune of stumbling on to the trail of Clark's party, whom they thus rescued from certain destruction.

Commander Peary had been on this coast in 1900, and so, having no fear regarding supplies of food, he proceeded to examine the coast from Nares Land, *viâ* Capes May, Bryant, Union, and Dawson to Cape Sheridan, where the *Roosevelt* was in winter quarters. There he enjoyed a much needed week's rest, although the weather was atrocious owing to a heavy gale of wind from the south. The journey, from the point where the expedition had turned back on the 21st April till they reached the *Roosevelt*, must have occupied about seven weeks. Commander Peary gives us dates of occurrences between the 21st April and the 2nd June, when he again left the *Roosevelt* and marched west "to fill in the unknown gap in the Grant Land Coast between Aldrich's and Sverdrup's 'Farthest.'" By the 16th June he had reached Aldrich's "Farthest," after which he passed on into unexplored land till he came on a peak the summit of which was about 2000 feet above the level of the sea. From the top of this he saw across Nansen's Strait on to the land which he had seen from the heights of Ellesmere Land in 1898 and had named Jesup Land in honour of the President of the Peary Arctic Club. In the maps which accompany this volume this land is called Axel Heiberg Land, the name assigned to it by Sverdrup. Having thus successfully filled up the gap, he began to retrace his steps on the 1st July under circumstances hardly more favourable than those of three months before, except that he had no anxiety about food. For marching in an Arctic summer is quite as severe work as marching in the spring.

Pushing his way east, Commander Peary, apparently about the 25th

July, came upon Marvin's party, from whom he learned that the *Roosevelt* "had broken out of winter quarters at Sheridan on the 4th July, and had squeezed down along the coast past Cape Union, where she was smashed against the ice-foot just south of the cape, tearing another blade from the propeller, and breaking off her stern post and rudder." On the morning of the 30th July he was once more on board. The necessary repairs to the ship were effected as promptly as possible, and preparations were made for the home journey, but more than once it seemed doubtful if the *Roosevelt* could make its escape from the ice, and Commander Peary went the length of laying out a plan of campaign for another year. Happily this was superfluous, as towards the end of July the pressure of the ice slackened, and the *Roosevelt* was able to make her way to Etah and thence to New York, where she and her gallant men arrived safe and sound on Christmas Eve. But even of the return voyage Commander Peary has to say: "This homeward voyage was the most wearing and annoying part of the entire expedition, compensated for, in part at least, by the return of every member of the expedition in as good or better condition than at starting, and the return of the ship with injuries of but a temporary nature."

Thus happily ended an arduous expedition, the main results of which have been summed up as these:—"The attainment of the 'highest north,' leaving a distance of but 174 nautical miles yet to be conquered this side of the Pole. The determination of the existence of a distant new land north-west of the north-western part of Grant Land, probably an island in the westerly extension of the North American archipelago. The distinct widening of our horizon as regards ice and other conditions in the western half of the central Polar Sea. The traversing and delineation of the unknown coast between Aldrich's farthest west in 1876 and Sverdrup's farthest north in 1902. The determination of the unique glacial fringe and floeberg nursery of the Grant Land coast." The mere enumeration of these, the principal results of the expedition, is sufficient to indicate the great obligations under which Commander Peary and his brave comrades have placed geographers, scientists, and all interested in Arctic exploration.

One of the most interesting chapters in a most interesting book is the last one, in which Commander Peary gives his impressions of the curious people whom he most appropriately and affectionately calls "my children the Eskimos." That he has acquired and deservedly retains an absolutely unprecedented and unrivalled ascendency over the Eskimo with whom he came in contact is abundantly clear throughout the whole volume, and it seems equally clear that the Eskimo under his personal influence will work and achieve success in a way which is not to be expected of them under other circumstances. Very little is known about the origin of the Eskimos. It may be true, as surmised by Sir Clements Markham, that they are descended from an ancient Siberian tribe, the Onkilon. According to Ratzel, they are found on the north coast of America from the point where the 60th parallel of North latitude meets the west coast by Mount St. Elias, to that where the 50th crosses that of Labrador over against Newfoundland; and they have physical

affinities with the races of North-Eastern Asia, linguistic affinities with the Indian races, and ethnographical affinities with the races of North-West America. The true Eskimo is dolichocephalic, and has straight black hair, dark eyes, and a reddish or yellowish brown skin; and he is of a cheery, good-humoured disposition, notwithstanding the hard struggle he has to wage for existence. Dr. Rink, who is the greatest authority on the Eskimo, conjectures that they once inhabited Alaska and migrated to their present locations, "either attracted by the riches promised by the sea, or driven out by hostile and more warlike Indian tribes." Nansen, writing of the Eskimo, says "he has a broad, good-natured face, with large features, small dark eyes, which are often set rather obliquely, a flat nose, fat round cheeks, a wide mouth and heavy jaws." His daily occupations prevent him from being cowardly or spiritless, and he is simple, kindly, and hospitable. The Eskimo with whom Commander Peary had to deal are depicted to us by an acknowledged friend and admirer. "Plump and rounded figures, emphatically expressive countenances, bronze-skinned, keen-eyed, black-maned inhabitants of an icy desert, simple and honest, occasionally sulky: wandering, homeless people: these are my children the Eskimos." That is one side of them. We also learn that they are inquisitive, resourceful, quick-witted, generous, hospitable, and with a strong sense of humour and—*very dirty*. "It is quite beyond the comprehension of these simple folk why washing should be considered necessary for the comfort of humans." But Commander Peary is very naturally drawn to the Eskimo, whom he has found trustworthy and hardy, for he believes that with his help some day "the world shall discover the Pole." No great consideration need be given to the statistics of population of such a nomadic people, but it is remarkable that the tribe which supplied Commander Peary's willing and trusty comrades seems to have dwindled from 253 in 1895 to 207 in 1905. A special word of commendation is needed for the excellent photographs with which this work is embellished.

FROM THE NIGER TO THE NILE.[1]

By Lieut. Boyd Alexander, F.R.G.S. (late Rifle Brigade).

(*With Map and Illustrations.*[2])

Before commencing the narrative of this expedition, it will be necessary to state briefly its object and composition.

The first work was to be a systematic survey of a portion of Northern Nigeria. The second was to explore Lake Chad, and the rivers between the

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[1] An address delivered before the Society in Edinburgh on November 21, 1907.

[2] The Illustrations in this paper are taken from Mr. Boyd Alexander's book *From the Niger to the Nile* (see review, p. 47), and we are indebted to the courtesy of the publisher, Mr. Edward Arnold, for the loan of the blocks.

Niger and the Nile, with the idea of demonstrating the wonderful system of waterways that connect the West with the East. Together with these primary objects, special attention was to be given to tribal distribution and orthography of native names, and a careful study made of the fauna to prove its affinity between the West Coast and the Nile.

The party consisted of my brother officer, Captain G. B. Gosling; Mr. P. A. Talbot; my brother, Captain Claud Alexander; and myself. With me I took my Portuguese collector, José Lopes. We were fully equipped with survey instruments. For the river work we took with us two steel boats, 26 feet long and 6 feet wide, drawing $1\frac{1}{2}$ feet to $2\frac{1}{2}$ tons. It took twenty-four men to carry each boat, which was in six sections. It would be hard to exaggerate their importance. In many places they did the

FIG. 1.—One of the steel boats on the River Yo.

work of bullock transport and carriers, which were impossible to obtain; and it must be remembered that it was necessary at times to support a large number of followers, sometimes two hundred in number, who had to be paid and fed. For this purpose a great amount of trade-goods were carried, besides provisions, survey instruments, and photographic apparatus.

The choosing and buying of the trade-goods was an extensive and arduous operation, which I fear our masculine nature did not altogether appreciate.

I recall the circumstance of a day's shopping at Evans and Company. I was wanting some unbleached calico or baft. I made my choice, and the girl behind the counter asked me how many yards I would require. When I replied I would take 5000, she with wonderful presence of mind said, "I think the manager had better attend to you—I will send for him."

As it happened, the manager had fore-knowledge of my case, and we soon got to business, which ended the incident in a different way to that which I am sure was looked for by the girl. Doubtless she waited expecting every moment to see the manager's apparent tactics of temporary pacification terminate with the arrival of some form of gentle restraint.

The expedition left England on February 27, 1904, and arrived at Lokoja on March 24. There it organised and went to Ibi, our first base for the survey work which was to triangulate through the country to Bauchi, and connect that place with our subsequent work in Bornu. The survey party travelled by way of the Murchison Range and passed through the country of the Montoils, Yergums, and Gurkawa, pagan cannibals who inhabit the hills. The early state of their civilisation is shown by the fact that they have not yet evolved as far as the village stage; each hamlet is against its neighbour; the stronger prey upon the weaker, with the result that the former inhabitants have been driven right up to the peaks of the range, where they now lead a precarious existence. They are very hostile to one another, and are continually raiding their supplanters below to get captives. It was astonishing to see how these pagans had irrigated and cultivated their fields and taken advantage of every available patch of soil on the hillsides. At this point progress was checked by both members of the survey getting ill, which necessitated their travelling to Wase, where there is a post. Here I might mention the Wase rock, an immense mass of igneous rock rising sheer out of the plain.

Having recovered their health, the party proceeded into the Angoss country past Mount Madong. The country was hilly, with numbers of isolated rocks like that of Wase. In these parts they came across an extraordinary amount of mica; the path followed shone with it like silver, and on either hand there were great sheets of it. Beyond the Madong mountains to the north-west lay a magnificent range with peaks 5500 feet high. This has been named the Claud Mountains in memory of my brother.

From Bauchi the work of triangulation was carried into the unexplored and interesting country of the Kerri-Kerris. It is only necessary to describe the town of Gamari, as it will be found typical of all the rest. Amid an alluvial plain rises a huge circular mass of chalk, with precipitous cliffs stretching sheer up on every side. At the top, 300 to 500 feet above the plain, the mass forms an absolutely level plateau, crowded with villages. In the midst of the plateau, again, rises a very steep peak of ironstone or laterite, which for about 50 feet mounts by huge steps or terraces straight as the walls of a house. From the top of the peak a most wonderful sight presents itself. One looks down on to the plateau and sees clusters of hamlets, each surrounded by a little wall of matting. Among them, and particularly along the edge of the cliff, are curious mud granaries. They are raised above the ground like hayricks or corn-stalks in England, and their height varies from 20 to 30 feet.

From the Kerri-Kerri country the survey party eventually reached

Asharka, the new base, where the boats and supplies had been brought by way of the Gongola river, with considerable difficulties owing to famine and the strong currents of the river.

From Asharka the survey party entered the Barburr country, and the work there was particularly arduous. At Dallwa it necessitated standing at times waist-deep in swamp, and my brother, only recently recovered from fever, collapsed. Then a most unfortunate thing happened. A message came in requiring his presence at a point on the Maifoni-Yola road. As the question involved the conduct of the survey, with characteristic thoroughness he considered it necessary to attend in person. He got up from his bed and rode to meet the officials, and then returned

FIG. 2.—On the River Gongola.

unable to stand, and in the grip of the illness he was carried into Maifoni for the last time, where, in spite of the untiring efforts of Dr. Parsons and Talbot, who, as physician and nurse, showed a splendid devotion, he died on November 13th, after a fight of six weeks, conscious and cheerful to the end.

The result of the survey, which we afterwards carried up to Kukawa, has been embodied in the map already published, and this work was not accomplished without much hardship, for there was illness to be overcome, and the hostility of natives met, and large numbers of carriers led and fed through famine-stricken countries.

Previous to this time I had taken a journey for zoological and exploration work through the interesting country lying between Loko on the Benue and the Gongola. It was at a place called Gaddam, which is about two days' march from Asharka, that I witnessed a Hausa wrestling-

match for the first time. Towards sundown the whole of the population repaired to the market-place, where a large ring was formed. On one side sat the king surrounded by all his court in their bright-coloured bernouses and turbans, and near to him, round the ring, sat the big men with their friends. Every one had put on some gay covering or ornament for the occasion, and the women had tired their hair and painted their eyes with blue. All were in merry mood and the scene was pretty and gay. The bright colours of the crowd mingled harmoniously in the soft light, and the mass was made more beautiful by a sprinkling of half-nude forms. There were groups of slaves with their masters' horses outside the ring by the palm-trees, and the arched heads and necks of two stock-still camels stood up like monstrous carved idols against the white walls of the palace. Beyond, the eastern sky was of the purest sapphire blue, fast deepening to reveal the bright points of the stars. The wrestlers were naked except for the short wrestling skirts of cloth gorgeously patched and ornamented with cowrie shells and tails of the chase.

The match was fought to an accompaniment of drums, the beats increasing in volume as the wrestling became more exciting. Great yells of applause now and again went up from the sea of black heads, and the women, whom the wrestlers were fighting for, egged them on by a continuous clapping of hands.

Before the match hands were shaken and umpires appointed in every move; the style was Graeco-Roman.

In all probability the mode has come through from Egypt after the Roman occupation, picked up by the travelling Hausa in the markets and bazaars.

By Christmas the expedition concentrated at Kaddai on Lake Chad, where in the meantime Gosling had brought the boats and stores by way of the Yo river.

From here Talbot and I carried out our first survey of the Lake. With the exception of a few island stretches of reed, there is good open water between the Yo mouth and Kaddai. The shore is quite open, with rough grass frequented by kob, gazelle, and large herds of hartebeest. There are gentle bay formations all along the shore, and the slope of the land to the water is so gradual that there are no banks, and, except in one or two places, the Lake can be reached without difficulty for there is scarcely any marsh, and the land is firm with a sandy soil. We made our first voyage with the object of gaining the Shari mouth, but we found it was impossible to go south; a great barrier of dense marsh lay to our right.

Our prospects the first day were anything but good, and the impossibility of getting into touch with the Buduma did not improve matters. Towards sundown we sighted a large fleet of canoes engaged in fishing operations. They had not observed us, and under cover of the growing darkness we stole silently along under the lee of a promontory, and came within 500 yards of them. Then a great commotion followed. The canoes were drawn up out of the water, and boats and men disappeared into the reeds. On account of mosquitoes star-work was im-

possible, and consequently latitudes had to be taken during the day. At night we were the prey of swarms of mosquitoes, and we longed for the morning to break, but no rest came with the rising of the sun, for clouds of flies tormented us, attacking with a heavy bite which, compared with the mosquito's, was as the hack of a butcher's dirty knife to the clean rapier thrust of a gentleman.

Taking a north-easterly course for several days we toiled along with hardly any progress, the boat often scraping along the thick mud. Our hopes were more than once raised by the sight of what we took to be Buduma settlements on some land to our right, but on approaching these they turned out to be deserted cattle stations, which consisted of reed-built huts very small in circumference, not more than four feet high, with the sides towards the prevailing wind always plastered with mud.

By now we found that our provisions had run out, and we were obliged to shoot gulls for food. By the following evening, however, our cartridges were almost finished, and we were forced to make for rats, which abound on the islands, digging them out of their holes and making humble pie of them, and this is how we lived for another six days, ever hoping to find a passage to the east; but, realising at last the necessity of bringing our trip to a close, we changed our course to west, and after a tedious winding through a network of islands, we emerged into open water. This continued for a distance of fifteen miles till the Yo mouth was reached, where we encamped on a small island, the site of a Buduma fishing-station, which presented a picturesque sight. There was a fleet of some twenty canoes, many full of dried fish, while hanging from frame-works of poles were fish in the progress of drying. Their canoes, made of thick bundles of dry reeds tied together and turned up at the prow, are most picturesque.

On December 23rd we arrived back at Kaddai, and Talbot left for England.

By the middle of February Gosling left for Kusseri, our next objective, and a week later I started with the two boats once more to try and find a way across the lake to the Shari. I took the direction of the Yo mouth, with the idea of following the influence of its water. We passed an island on the way, where I counted a herd of sixty hippopotami that had been driven to the lake by the falling of the river. Five miles beyond the Yo mouth we struck a north-easterly direction. At a Buduma fishing island, I induced two boys to come with me as guides. For sixteen miles we found good open water, and then our course lay through a mass of small islands, through which we struggled on for ten miles, the men often wading and pushing up to their chests in mud. The next morning I found that we were near the east shore of the lake, for there were horsemen to be seen on the land about a mile beyond the island.

My difficulties were increased by the Harmattan wind. It would rise daily at 9 A.M., and by 12 o'clock the sun would be blotted out by a dense, damp mist, through which we had to grope our way, miserably cold. To show how strangely the water shifts with the wind, one morning, in retracing our course of the evening before, we found the water had gone, leaving numbers of fish of enormous size, some four feet

long, stranded. As I could find no passage southward, and my men were worked out, I decided to retrace my way to Kaddai and refit for another attempt.

On March 2nd I took the same course as our first, again determining to find a south-west passage, but the reeds still proved impassable. On the outward journey we came upon a large Buduma fishing-fleet. At first they mistook us for other Budumas, whom they considered an easy prey, for it is their habit to plunder one another when they get the chance. Accordingly, they closed up ready for attack. But soon they realised their mistake, and the tables were turned. Before we could get up to them many of the boats burst into flames, and the Budumas, swimming like otters underneath the water, disappeared into the reeds. Hidden in the boats we found four slave boys, who were the victims of a traffic carried on between the Budumas and Tubus. They were in a shocking condition, and we took them back and released them at Kaddai.

We then determined to try and cut through the reeds. We worked steadily for two days, cutting a distance of about 800 yards, and beyond that I waded a mile, but there was no end to the reeds and "maria" bush.

I then relinquished this, my third attempt, and once more returned to Kaddai. When within half a mile of the shore, we found the water had disappeared, and as it was late, the men slept in the boats, and my bed was put up in six inches of water, and that night I slept on the floor of the lake. In the morning the water rose earlier than I did, and I had just time to get out of bed as the lake was getting in.

I then abandoned Kaddai as a starting-point, and trekked with the boats' sections to Seyurum, a distance of twenty-five miles, which was the next point to the south where there was open water. This took me a month and a half owing to desertion and sickness.

From Seyurum I made my fourth and last attempt, which necessitated three days' cutting through great belts of reeds, papyrus, and maria bush which extended as far as eye could reach. We were obliged to spend the nights huddled up in the boats. Sleep was out of the question owing to the hordes of mosquitoes. Many of the men preferred to sit up to their necks in water all night.

On getting through the reeds, we found the aspect of the lake quite different from that of the Yo basin. Instead of low islands, there were big island stretches, which formed continual promontories ahead, overlapping one another on either side of our course, with channels sometimes not more than 100 yards wide, at other times forming deep bays as much as two miles in width, lined with belts of dark green maria 10 to 30 feet in height.

Up to this time the Budumas had held severely aloof, but now a Kachella, or chief, of a large fishing-fleet we met, saluted us, and offered to show us the way to the other side. On the way he took us to his island, Karraragga, where we rested for two days. This island presented a very fertile appearance; the delicate green of young mimosa leaf was a pleasant sight after the sand-swept stretches of Bornu, and large herds of cattle were to be seen on the island. The Kachella's town consisted of

reed huts. Each dwelling has its low round mosquito-proof house covered with close-woven matting.

On leaving the island I went to Wunnda on the east side of the lake, thence followed the shore to the mouth of the Shari. About twelve miles before reaching the Shari mouth, one leaves the great sombre maria belts behind and comes out into magnificent open water, and Chad for the first time assumes the grandeur of an African lake.

Before leaving Lake Chad I will attempt to give a general idea, based upon the observations I was able to make. As regards the size, I made it considerably less than it was formerly supposed to be. There is an idea that the lake is drying up, but except for the loss of water caused by the disappearance of the Bahr-el-Ghazal, my opinion is that it does not alter very much, and I believe that the supposed greater original area is simply due to inaccurate survey and partly to the fact that the villages on the Bornu side are several miles distant from the lake, which has given the impression that these determined a former shoreline. But I think that the sole reason for their position is one of security, for, as there are no containing banks, and the land and water being almost level, the Harmattan, which causes the water to flow 600 yards over the land with an ordinary wind, drives it as far as two miles when the wind is strong. Besides, I was told by the King of Kowa, a town situated eleven miles from the lake, that in a great flood twenty years ago the water had reached as far as the town, and in another, seven years ago, it had risen past it and covered the plain as far as a place called Mongonu. While the flood lasted, the Budumas went up in their boats and established a fish-market just outside Kowa. On the eastern shore, where there are good banks, and the water is not influenced by the prevailing wind, there are many villages close to the lake.

Another fact that has perhaps created the impression that the lake is decreasing is that chains of islands that once were separate are now more or less joined together by marsh. But I think that this may very likely be due to the silting up of mud and sand against the obstruction of the islands by the opposing influences of the Yo and Shari, the two rivers that feed the lake. In fact, my observations go to show that the lake is practically two lakes, divided by the fifteen miles or so of marsh and maria bush that I attempted to cut through, and these form the separate basins of the two rivers. Moreover, a Buduma chief told me that there was no communication between the two parts, and I found that the people on the different sides knew little of each other. This impression is further borne out by the very marked difference in the character of the scenery and the people. On the north, the shores are flat and bare, and the surface of the water, which is nowhere more than 4 feet deep, is broken up by small uninhabited islands that are little more than sand-flats. The people are neither numerous nor flourishing, and lead a lawless existence. But in the south or Shari basin, everything has a more flourishing appearance. The depth of the water is from 5 to 9 feet, and the islands, which form prominent features, are fertile and thickly inhabited. Everywhere the maria-tree grows luxuriantly, and its close dark foliage gives a sombre character to the

scenery. This is the real home of the Buduma, who are a prosperous and enlightened people, gaining their wealth by fish and potash, and counting it in number of wives, slaves, and herds of cattle.

Previous to my work on Lake Chad, I had the fortune to witness a Tubu raid upon the Mecca caravan. At that time the Yo districts were in a most unsettled state; natives went about fully armed, and only travelled by night, for fear of the Tubus, who were on the war-path. These people are the nomad robbers of the Sahara. Armed with long spears, and mounted on small ponies and camels, they cover long distances, concentrating suddenly when a raid is contemplated, afterwards to scatter and as quickly disappear. Many of the lawless Mobbur are their worthy allies, acting as spies, and sharing a portion of the spoils. While the last great Mecca caravan was travelling through this country, escorted by the Kachella of Yo, it was heavily ambushed near Bulturi; the Mobburs opened the attack by flights of poisoned arrows, while the Tubu horsemen charged on the flanks, cutting off numbers of the flocks of the caravan, which spread over two miles of road, and numbered seven hundred people and nearly a thousand cattle. With the loss of twelve men and thirty horses killed, the Kachella, who had eight spear-wounds, with his hundred horsemen kept the enemy at bay, and under the protection of darkness brought the harassed caravan into Bulturi, where for five days the Tubus hemmed it in. On the fourth day the Kachella managed to get a runner through to me. Accordingly, with all the arrowmen and horsemen I could muster at Yo, I reached Bulturi in time to relieve him.

Just outside Bulturi we crossed the scene of the Kachella's fight, where lay the rotting carcases of the horses that had fallen victims to the poisoned arrows of the enemy.

The effect of the poisoned arrows is very deadly and sudden. In a few minutes the victim is thrown into convulsions to which he quickly succumbs, with discoloration and swelling of the body.

The Mallams hold the secret of an antidote to the poison, and this they impart to the big chiefs, who are thereby rendered proof against its powers. It is in the form of a liquid drug which acts as a preventive, and fighting men like our Kachella take a daily dose.

There are many false Mallams who pretend to possess the secret drug, and by spurious imitations drive a large trade with the natives, which they can of course carry on for a long time with small chances of being found out, for their patrons are hardly likely to show their faith in the drug by putting it to the test by running purposely against a poisoned arrow, and when one happens to come their way it hardly leaves them time to institute proceedings against the Mallam for fraudulent misrepresentation.

At daybreak we moved out of the town. It was a picturesque sight. Whole families were there, driving their flocks and carrying with them all their worldly belongings, and their children, perched on the backs of bullocks and camels.

Amongst this pilgrimage there travelled pale-faced Fulanis, Hausas from Sokoto, handsome dark-skinned people from Melle and Timbuktu,

and many Mallams or priests, turbaned and clothed in white, walked calm and heedless of the danger, incessantly telling their beads. When close to Yo the Tubus were dispersed, for their leader had been killed, and the Kachella's warriors concentrated and advanced past me in a long line towards the town, and then the women and children crowded round the king, asking for news. All night long the hours were broken by the wail of women calling upon their dead men to return.

To go back to the expedition. Ascending the Shari, we travelled through the land of the Kotokos, the giants of the Sudan; and at Gulfei the big Kotoko chief, some six feet three inches in height, received us with all his infantry and horsemen.

From Fort Lamy onwards the Shari region is thinly populated.

Fig. 3.—Fulani Architecture.

Between Bousso and Fort Archambault there are no villages, and this magnificent river flows through a silent land, untouched by traffic of any kind, and one can travel for days without meeting a single native canoe.

During our journey up the Shari the amount of game we met with was truly wonderful. On different occasions Gosling obtained elephant, giraffe, buffalo, rhino, hartebeest, bushbuck, duiker, waterbuck, roan antelope, kob, ostrich, pig, and wild dog. This was accounted for by the fact that the dry season causes all this game to concentrate near the banks of the river.

From Archambault we explored the Ba-Mingi river, hitherto unknown to the explorer, and found it quite navigable, except for rapids about four miles from the mouth. The river has pretty scenery: some-

times the banks rise to a height of 120 feet, formed by rocky knolls, and at these points the growth becomes tropical. For 130 miles, the distance we travelled up this river, we found the country uninhabited; and the impressive solitude was only disturbed by the herds of elephants, which at times frequented the gravelly sandbanks, and troops of baboons that followed us along the banks, gazing in excited wonder at our boats.

We next ascended the small rivers Gribingi and Nunna, and crossed the Shari-Ubangui watershed carrying the boats for four days. Then we descended the Tomi river through a well-watered and undulating region. Here the character of the vegetation changes. Thick belts of forest full of rubber vine hide the streams, and the fauna for the first time belongs to the forest region.

In this part of the country the natives have a barbarously cruel method of hunting elephants. When a herd is located in the dry grass all the villagers turn out with guns and spears and fire the grass all round the herd. The poor beasts make frantic attempts to break through the ring of fire, and are to be seen rushing madly to and fro in their agony, rooting up trees and throwing grass and earth over their scorched backs.

A journey of four days down the Tomi river brought us into the Ubangui, or "drinker up of little rivers," a great stream some 1200 yards in width, swelling to a mile at the bends. Its banks are fringed with trees, with undulating grass beyond. On either side chains of gently-rounded hills, devoid of trees save in the hollows and ravines, loop sometimes close to the river line and sometimes wind away to a distance of a day's journey.

At Mobbai the river appears to be a dividing line between a sterile and fertile land. On the right bank are treeless hills, on the left extensive tropical forests wind along the valleys.

As regards the inhabitants, space does not permit me to mention more than the Banziris and the Yakomas. They are fine races, especially the Yakomas, whose men are veritable giants, and the finest specimens I have seen anywhere in Africa. All along the river there are thickly populated villages, some over a mile in length, and the appearance of the people strikes one as being extremely healthy and prosperous. The young girls of the Yakoma race deftly weave long plaited cords of black twine into their hair, which, falling over their shoulders to the ground, give the appearance of their possessing luxuriant tresses.

On January 1st we arrived at Yakoma, a large Belgian post at the mouth of the Welle, and the next day we left to ascend the river, whose course has a width of from 800 to 1000 yards, studded with rocks and flowing through an ironstone country, where the natives work mines to a depth of 90 feet. A few days later, in a thick mist, we set out to pass the Voro rapids, about three days below Djabbir, the strongest and most dangerous on the Welle, stretching a distance of three miles, and sometimes a mile wide, cut up by a mass of small rocky islands covered with palm-trees and tropical growth, between which the water rushes and tumbles headlong, the foam flying many feet into the air.

The violent uses the boats had now been put to had caused splits to appear, and I was at a loss to find a wherewithal to mend them, till I luckily remembered having seen a native woman mending her pots with the wax of wild honey, and it struck me at the time as so interesting that I made a note of it. And now I tried it with unexpected success. Wooden wedges were driven into the cracks, and then sealed over with the melted wax. The restoration was complete, and Samson's riddle reversed, for out of sweetness came forth strength.

Except for good water between the Angba hill and Niangara, the entire course of the Welle is cut up by rapids and hidden rocks. The river folk are the Bakango, a numerous people, whose conditions have greatly improved since the Belgian occupation, for its protection shields them from the raids of the fiercer forest tribes.

It was at Angu that we first heard rumours of the existence of the okapi in the neighbourhood, where in the forest, some three days to the south-east of that place, we spent three weeks endeavouring to obtain one. The okapi, or *n'dumba*, as it is very widely known by the natives, is very locally found, and Angu is the only part near the Welle where it is met with. We found its haunts were small streams running through swampy ground, thickly overgrown with a clean-stemmed plant some 6 to 8 feet in height, with large oval shiny leaves bunching at the top, the young shoots of which are an essential food of the okapi. In these localities it roams about singly or in pairs, and, according to the Mobatti hunters, three may occasionally be found together. Gosling, although he got to close quarters with one on three occasions, never saw it, so perfectly concealed was it among these leaves. He says: "During the night the okapi will wander along in the mud and water in search of the young shoots of this plant. Here he may be found feeding as late as 8 A.M., after which he retires to the seclusion of the forest, where he remains until dusk. In the glades and clearings I found his spoor on ground frequented by buffalo and waterbuck, but this is unusual, for his companions in the forest are more often the elephant, the greater bushbuck, and the yellow-backed duiker." At this time José had been following a solitary animal for three successive mornings in the vicinity of a stream. He observed that, on leaving the water, the okapi always took the same course, between two large trees, about a hundred yards from the stream. So, with the help of natives, he dug a pit $4\frac{1}{2}$ feet deep between the trees, and then carefully concealed it with branches and leaves. Very early next morning José again approached the stream and heard the noise of the okapi rushing away. Soon there followed a loud thud, for the animal, taking its usual course, had fallen into the pit, and was secured. Owing to the thick leaf and forest, its restless nature, and keen hearing, even the natives find it difficult to track, and are obliged to resort to the method of trapping it in pits. They regard the animal as a mysterious creature, and say that it is always moving, and never lies down to sleep. José's observations bear this out, for on several occasions when he heard it feeding it simply paused to take a leaf here and there, and then passed on again.

This portion of the journey was the most trying to the health of the

party, the long stays in the hot, steaming forest hunting the okapi, and the work on the Welle, which has an evil reputation for being the breeding-ground of bilious and blackwater fever, told severely upon our already weakened constitutions, and we were all attacked by fever. It was at Niangara that the expedition received its last great blow. Gosling was struck down with blackwater, whose deadly attack he laid himself at the mercy of by his refusal, almost to the last, to abandon his labours.

Leaving Niangara with a heavy heart, I next ascended the Kibali, which has never before been navigated.

Along this river there are many formidable rapids. Among these, the Andimanza, which stretch for a distance of two miles, present a scene of wild grandeur. The river here swells out to a width of 400 yards, and is broken up by small rock-bound islands, which cause tremendous chutes.

We next ascended the Ira or Bakwa. The whole way we came upon numbers of elephants, which, so unaccustomed to man, allowed us to approach quite close, and it was a pretty sight to see them playing on the banks and bathing in the water.

From here I penetrated by road into the country of the hostile Mombuttu, south of the Ira. The scenery is grand. A mass of mountainous hills roll away, range on range, in glorious confusion, their steep sides darkened with trees, save where they are scarred by clefts and sharp angles of bare rock. And below in the deep valleys the courses of innumerable streams are revealed by their coiling coverings of tropical green. From here, where I climbed to a height of 4000 feet, far away to the eastward on the horizon, I saw for the first time the grey blur of the hills of the Nile.

Finding it impossible to reach the Nile by the river system to the east, owing to impassable rapids and hostile natives, I trekked with the boat to Yei, eight days' distant.

On October 13, 1906, I started to descend the river. At this point it is little more than a rocky mountain stream 25 yards wide, and some 50 miles from its source in Mount Watti. For the first 20 miles we passed a succession of rapids in terrace formation, rendered more difficult by the obstruction of small green islands. It was laborious progress, sometimes only a mile a day was made, and the boat had to be got past the rapids by the men hanging on to the chain from the stern in the water. Sometimes trees, fallen right across the stream, had to be got through. At other times, where a passage allowed, we took the risk, and shot the rapids. The boat was now in such a battered condition that frequently after the passing of a rapid it had to be drawn out of the water, a fire lit, and the wax melted, and the wedges renewed.

At the Azandi village of Kapi I saw the interesting ceremony of the signing of a treaty between the chief and an ancient foe. They met, each surrounded by his followers, and their headman made incisions in the chiefs' arms, and with a feather mingled the blood of one with the other.

From Kapi for 23 miles the river is good, with the exception of two

rapids, the second of which was one of the worst, and certainly the most disastrous, we had to encounter. Owing to the tremendous current, the men on the chain behind for a moment relaxed, and the boat was driven with terrific force against an overhanging tree. The shock swept off two of the polers, who disappeared into the torrent never to be seen again.

In the open reaches we came across numbers of hippos, and their closely cropped feeding-grounds by the river-side afforded us excellent sites for our camps. They were not always successful in getting out of our way in time. On one occasion as the boat was coming down at a rapid pace into a pool, we were all thrown together by a tremendous bump, and for a moment all thought we had struck upon a rock. But the rock snorted and plunged out of our way.

Near the station at Wandi the river is quite unnavigable. In places the boat had to be unloaded and dragged over the rocks, so as to avoid the chutes, which were gigantic. The river in appearance ceases to exist, and the water pours itself as best it may over the slabs of rock with which the whole length and breadth are strewn.

For 100 miles after leaving Wandi, there are nothing but rapids the whole way, and the one six miles from Wandi is the biggest we had yet seen, and presented a splendid spectacle. Here the river is 300 yards across, and a great volume of water sweeps foaming over steep rocks, past islands covered with beautiful palm-trees, which are the resort of dog-faced baboons. In the neighbourhood of Raffai appear small hills of not more than 400 feet. These are inhabited by the Miza people, a tribe that struck me as rather original. The men, who are smooth-skinned and gentle, adorn themselves with bead ornaments and girdles of beautiful design, while the women affect a masculine severity of costume, fruit-stones taking the place of beads. At Avurra the Yei becomes a splendid river, with an average width of 60 yards, and the country throughout is well populated.

It was now December, and the river was rapidly emptying itself; in places there was hardly enough depth to clear the keel of the boat, and it became a race between us and the water. To hasten our pace, we threw away all our belongings with a light heart, for our spirits were high as we had said good-bye to the rocks. For about twenty miles to near its mouth, the Yei flows through a flat, fertile country, where large herds of cattle and sheep roam at will. Often along the sloping banks one sees the brilliant green of young tobacco plantations. This is the land of the Dinkas, who on our first appearance ran away, but later, gaining confidence, flocked down to the river and lined the banks in hundreds. All naked, and with their bodies painted a ghastly white, they shouted and danced and threw their long spears into the air. So we made sixty miles, then trees, flocks, and men gradually disappeared, and the river wound along through a vast empty plain. It widened and slackened, and the impression came over me that it was nearing its journey's end. Eagerly we craned our necks for a sight of the Nile, but this reward was still withheld; nothing but marshland as far as the horizon met our gaze. We followed the river till it lost itself in a lake surrounded by dense reed and sudd. We crossed the lake with irresistible recollections

of the Chad, and then found ourselves stopped by the barrier of marsh and sudd which choked our passage to the Nile. I then trekked 38 miles with the boat sections to Gaba Shambi.

At the end of a waterless day's march I had refreshed myself at a waterhole by the roadside, and was lying down resting, when I saw a string of donkeys approaching on the road from Gaba Shambi.

I was tired, and so lazily did I watch them that had they vanished the next moment I should not have rubbed my eyes. But as they came near I was suddenly aware that behind the caravan rode a smart Englishman.

In a moment I was on my feet pressing forward to greet him.

So good was the sight of a fellow-countryman that this stranger might have been a lifelong friend of mine. "How are you?" I said, grasping his hand. He stared at me, and then I remembered I was dressed in nothing more than a ragged shirt and running shorts, and sandals made of the skin of a waterbuck. "Where have you come from?" he said, and when I replied "From the Niger," he answered, "Oh, now I know who you are." Then he introduced himself as Major Mackworth, and kindly told me to help myself to his stores when I should reach the station.

The next morning as we neared Gaba Shambi we came in sight of the great river lying beyond. Whereupon the boys all shouted *Aiki yo kare*, "The work is finished," while I gazed in silence on the Nile.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Sir Charles Bruce, G.C.M.G., J.P., D.L., late Governor of Mauritius, will address the Society in Dundee, Aberdeen, Edinburgh and Glasgow on the 14th, 15th, 16th and 17th January respectively. The title of his lecture will be "The Evolution of the Crown Colony of Mauritius." Mr. George G. Chisholm, M.A., B.Sc. (Edin.), F.R.G.S., will lecture on the 28th of the current month in Aberdeen, 29th in Edinburgh, 30th in Glasgow, and 31st in Dundee. He will make "Economic Geography" the subject of his address.

GEOGRAPHICAL NOTES.

Europe.

The Tree-limit in the Scottish Highlands.—In *Nature Notes* for November 1907, Mr. Hugh Boyd Watt gives an interesting account of the characteristic trees of the Scottish mountains and their upward limits. The observations were made chiefly in the Braemar district, and also at Tomintoul, Banffshire. In general it may be said that 1500 to 1700 feet marks the tree-limit, but exceptionally trees occur up to 2000 feet. The following species occur above 1100 feet (the height

of the village of Braemar):—Lime, Great Maple, Laburnum, Scotch Laburnum, Horse Chestnut, Wild Cherry, Bird Cherry, Whitebeam, Mountain Ash, Hawthorn, Ash, Elm, Birch, Hazel, Alder, Oak, Beech, Willows, White Poplar, Aspen, Spruce Fir, Larch, *Abies hookeriana*, Scots Pine. Among these the Scots pine and birch are the most important, the pine predominating at the higher levels. The mountain ash ascends in solitary specimens to 2000 feet, but hazel is scarce at the higher levels, and oaks do not predominate above 700 to 800 feet.

Africa.

Bantu Phonetics.—We have received a copy of an article on Bantu Phonetics by the Rev. E. Jacottet, of Basutoland, the article forming a supplement to the September number of the *Christian Express*, Lovedale. The article is in the main an account of Meinhof's work. This author's books have not been translated from the German, and Mr. Jacottet's object is to make his work known to those interested in the Bantu languages. The paper refers more especially to Kafir and Sesuto, and the paper may be recommended to the notice of those interested in these tongues.

The Age of the Great Zimbabwe Ruins.—We have received from Mr. R. N. Hall two pamphlets bearing upon the disputed question of the age of these ruins. One is a little Guide to the Ruins, containing charts and illustrations and incidentally containing references to facts which in the author's opinion disprove Mr. MacIver's views as to the date of the buildings. Mr. Hall claims for the Elliptical Temple an origin at some period before the arrival of the Makalanga from north of the Zambesi (about 1200 A.D.), though he accepts Mr. MacIver's estimate as regards some of the poorer and later buildings at Zimbabwe, and rejects Mr. Bent's estimate of 2000 B.C. He agrees with those authorities who are of opinion that the Great Zimbabwe Temple, whatever its date, does not determine the age of the ancient gold-mines, many of which are more ancient than it, but believes that the Temple "represents a resultant phase in later times of intrusions into these territories of both Arabs of South Arabia and people of Western India in ancient times." In other words, Mr. Hall supports the view of Semitic influence as against Mr. MacIver's view of purely native origin.

The other pamphlet is a reprint from the *African Monthly*, entitled "Notes on the Traditions of South African Races, especially of the Makalanga of Mashonaland," and has for object the proof that native tradition in ordinary matters extends back to one hundred and fifty years, and in special and leading matters to two hundred or even three hundred years, and that therefore if the Ruins had the late date which Mr. MacIver assigns, some tradition of their origin should exist among the tribes, instead of which no tradition or even legend exists.

We cannot here discuss the question as to the side on which

the balance of evidence lies in regard to the date of the Ruins, but in view of the long review given to Mr. MacIver's book last year (xxii., p. 575), it is only just that Mr. Hall's position should also be stated.

The Canary Islands.—An author in *Questions Diplomatiques et Coloniales* for August 1 gives a somewhat gloomy account of the condition of these islands, which have apparently been greatly neglected by the Spanish Government. About half the population cannot read or write, the means of communication are in a very backward state, water is deficient, and large areas remain uncultivated. As regards ownership, the Archipelago is still under the reign of the feudal system, for the land is divided among a few powerful families. In consequence the density of population is low, and is increasing very little. The majority of the people are extremely poor, and vegetate miserably or emigrate to Cuba or the South American republics. The isolation of the islands may be realised from the fact that there is only one cable to the mother country, which is more frequently interrupted than not. Three islands, Gomera, Hierro, and Fuerteventura, numbering in all 35,000 inhabitants, have never had a telegraph, and communication between the four islands is carried on chiefly by a small steamer which visits them once a week. The post is mostly left to foreign vessels, and the freight between the Archipelago and Spain is four times that between the islands and London, although the time of transit is forty-eight hours against seven days. The local administration is in a deplorably bad state, and although a programme of reforms was drawn up last year there is no indication that it will be carried out. Nevertheless, from their position the islands are of great importance, and will become increasingly so when the Panama Canal is opened. Although the soil, volcanic in origin, is in places deeply ravined and rocky, and water scanty or at least badly distributed, yet the climate is superb, the water difficulty could be got over by skilful engineers, and the soil in places, especially when mingled with vegetable matter, is of great fertility. Almost all the plants of warm countries will thrive, and a great variety have been grown in the islands. At present the chief sources of wealth are the fisheries and the production of fruit and of early vegetables for the markets of Europe. The wealth of fish is great, but the methods of preparation are so insufficient that the exportation of the products is difficult. Hitherto trade has been chiefly carried on with Great Britain, but Germany is now rapidly pushing to the front. Trade with the mother country is handicapped in every possible way, with the result that the bananas of Las Palmas are sold in London at half the price which they cost in Madrid.

America.

Glacier Advance in Alaska.—In our July issue (p. 382) we gave some account of the advance of the Malaspina glacier, in Yakutat Bay, Alaska, as noted by Professor Tarr. We have since received a reprint from the *Bulletin* of the Geological Society of America in which Professor

Tarr gives a fuller account of the observations made in the region, accompanied by some very fine photographs. This paper shows that the advance is occurring in some but not in all the glaciers of the region, and that it is producing some interesting effects. Thus the crevassing and breaking off of masses of ice produced by the advance is exposing an enormous surface of ice to erosion which was formerly protected, and the result is a large increase in the size of the glacial streams. The old moraines furnish an enormous supply of débris to these enlarged streams, and thus the whole rate of erosion is being quickened. Again, the area of iceberg discharge is being increased, and this may ultimately even prove a menace to navigation. The increase is also of interest because in this region, as in so many others, the whole recent history of the glaciers points to recession, and the sudden, violent, forward movement, without climatic change, may necessitate a revision of the interpretations which have been put upon past movements of advance in different parts of the earth's surface.

The Bogoslof Islands.—In vol. xxiii., p. 46, mention was made of the appearance of a fresh island in the Bogoslof group in 1906. It appears that further disturbances are still taking place in the same group, for it is reported from the Dutch Harbour Station that the U.S.S. *McCulloch* found Bogoslof Island much changed on a visit made on October 15. McCulloch Peak has quite disappeared together with half of Berry Peak, as the result, it is believed, of a volcanic eruption. The neighbouring mountains have also been much modified by the discharge of lava dust.

Plant-zones in the Rocky Mountains.—In *Science* for November 8, Professor Francis Ramaley proposes a classification of the plant zones as seen on the eastern slope of the Rocky Mountains, especially in northern Colorado, which differs in some respects from that proposed by Schimper for mountains in general. The basal region he calls the *Plains Zone*. This extends up to 5800 feet, and is a grassland formation, the grasses being mingled with coarse composites. Trees and shrubs only occur along watercourses or on rock ridges and buttes. The *Foothill Zone* extends from the limit of the above to 8000 feet; it consists generally of an open forest of *Pinus scopulorum*, with a few cedars (*Sabina scopulorum*), Douglas spruce (*Pseudotsuga mucronata*), and some deciduous trees in the canyons. From 8000 to 10,000 feet occurs the *Montane Zone*, consisting of denser forest in which *Pinus murrayana* predominates, while *Pinus flexilis* and *P. scopulorum* also occur with *Picea engelmanni* at the upper limit of the zone. From 10,000 to 11,000 feet occurs the *Sub-alpine* zone with forests of *Picea engelmanni*; the balsam fir (*Abies lasiocarpa*) and *Pinus flexilis* form secondary species, and huckleberries are abundant as shade plants on the forest floor. In the upper part of the zone a considerable area of mountain meadow occurs, and "wind-timber" runs up in tongues to various altitudes. Above, and extending up to 14,000 feet and beyond, is the *Alpine Zone*, which consists of rock-desert and steppe. Mat-forming plants and deep-rooted perennials

are common, while large areas are clothed only with lichens. Numerous sedges and grasses are found, but seldom form a dense sod, being mixed with various flowering herbs. Dwarf willows occur, which often form a dense scrub, but there are no other woody plants.

Australasia.

The Tasmanian Race.—It is a commonplace of anthropogeography that the Tasmanian race is entirely extinct, the date of death of the last male representative of the race being usually given as 1869. It is therefore of much interest to note that according to a paper in the *Proceedings* of the Royal Society of Victoria (xx., pt. 1). Dr. Richard Berry has discovered a half-caste woman of this race in Kangaroo Island, which is situated off the entrance to the Gulf of St. Vincent, on the coast of South Australia. It appears that the wandering European population which first inhabited this island were in the habit of seeking wives in Tasmania, and the woman named above is the daughter of a full-blooded Tasmanian woman and a white man, and was born on the island some seventy-five years ago. Dr. Berry emphasises her resemblance to the Papuan type, and supports the view that the Tasmanians represented a Papuan stock, which formerly inhabited both Australia and Tasmania, and were driven out of Australia, or exterminated there, by the incoming of a new race, the Australian aboriginal, though the possibility that the existing Australian represents an admixture of the incoming race with the Papuan stock must not be lost sight of. Dr. Berry appeals for a closer examination of the characteristics of the Tasmanian race.

Polar.

The Inland Ice of Greenland.—According to a calculation by Mr. Prytz, quoted in *La Géographie* for August 15, the great sheet of ice which covers the interior of Greenland, and which is the largest glacier of the Northern Hemisphere, has an area of 713,500 square miles, that is, approximately an area equal to three and a half times that of France. Mr. Prytz gives to Greenland as a whole an area of 827,500 square miles, so that after Australia it is the largest island on the globe, and to the narrow band on the west outside the inland ice which forms the Danish colony, an area of approximately 45,000 square miles.

Argentine Antarctic Research.—Dr. W. S. Bruce, of the Scottish Oceanographical Laboratory, has received information from Buenos Aires to the effect that the ship *Austral* is getting ready to go South, and that she will probably have started during the month of December. It seems likely that Mr. Davis, of the Argentine Meteorological Office, will have another Meteorological and Magnetic Station set up on Wandel Island for the coming year.

General.

The Geographical Congress at Bordeaux.—In the *Questions Diplomatiques et Coloniales* for September 1, M. Henri Lorin gives an

interesting account of the proceedings of this Congress, which was announced in our March issue, p. 161, as one of those to be held during the past summer. Among the papers setting forth original work one of the most striking was an account given by M. Postumus Meyjes of recent exploration in Dutch Guiana and Dutch New Guinea. In Guiana the dense forest of the interior has now practically been explored, and a railway will be shortly constructed from Paramaribo to the gold producing districts of Ava. The interior of Dutch New Guinea, on the other hand, is still unknown, but exploration is being pushed on and it is expected that at the present time the surveying parties will have reached the foot of the unknown snow-capped mountains of the interior. M. Meyjes is engaged in the production of large-scale maps of the tropical colonies of Holland, and showed some specimens of his work to the Congress, for he is both explorer and cartographer.

M. Frantz Schrader made a very stirring speech to the Congress on the necessity for the conquest of the North Pole, not as a mere sporting record, but as a means of obtaining the necessary data for the forecasting of the weather of Western Europe. He advocated the establishment of some fixed stations which, with the aid of some special ships, and wireless telegraphy, would furnish exact observations on the ice-conditions in the North American polar latitudes, which are again believed to determine the weather of Western Europe. The subject is to be further studied during the present winter by a committee who are to report to the International Congress of Geography at Geneva next summer. Other interesting discussions took place on re-afforestation and on the teaching of geography. In the latter, stress was laid upon the utility of geographical societies in diffusing a knowledge of geography, and on the fact that geography is a science which cannot be too widely popularised, that it is indeed a means of conveying exact knowledge and scientific method to the general public.

Among papers on regional geography was one on the *Landes* by Professor Larroquette, who showed how this region has been transformed by the planting of the maritime pine (*Pinus maritima*), literally a tree of gold which has spread comfort all round, and has turned the district into one of the richest in France.

A New German Journal.—We have received a copy of a new periodical entitled *Dietrich Reimer's Mitteilungen*, issued by the publisher of this name at Berlin, which is intended for settlers, farmers, tropical planters, and others interested in colonial work, especially in the German colonies. Four parts are to appear per annum. The issue sent to us, that for September, contains an article on the growth of rubber in German colonies, followed by a useful list of books dealing with the plants producing rubber, culture methods, etc., also an article discussing the physical qualities which should be present in persons intending to live in the tropics. This is followed by a bibliography of recent books and maps relating to the German colonies, and another list of some recent books and papers dealing with the people and lands of the less well-known regions of the globe.

Commercial Geography.

The Argentine Republic.—An article in *Questions Diplomatiques et Coloniales*, for September 1, discusses various points in regard to the economic development of the Argentine Republic. In the first place, it is to be noted that the country is well endowed naturally with navigable rivers, and the first necessity has been to establish ports, and to construct railways having for their object the bringing into communication of the different river systems. If Buenos Ayres is the first port, Rosario, the agricultural capital, and the natural entrepôt for the produce of the eight provinces whose outlet is the Parana, is certainly the second. Here some elaborate harbour works have been carried out, chiefly with French capital. Buenos Ayres, which differs from the other Argentine ports in being both a port of importation and exportation, is also furnished with very elaborate harbour works, while of the other ports Santa Fé, where the State has begun the construction of a modern installation, may be mentioned. At the same time the Parana has been deepened, and various canals have been constructed, notably one from Marchiquita to Baradero, which serves a rich agricultural zone in the province of Buenos Ayres. Valuable as the waterways are, however, they are insufficient to develop the country without the aid of railways. Of the provinces those most active in railway construction are Buenos Ayres, Cordoba, and Santa Fé. Proportionately to the number of her inhabitants, the Argentine is the country best provided with railways after the United States, for it has 37·6 kilometres per 10,000 of its inhabitants, as against 11·8 in France and 6·46 in Belgium, but proportionately to the area of territory to be exploited, her railway system is not as yet adequately developed. The traffic both of passengers and of merchandise on the existing railways is steadily increasing, so that there is every probability that new lines will be a commercial success, and these are much wanted. On the other hand, the debt is already large and the amount of foreign capital invested means heavy taxes in order to pay the interest, while these heavy taxes again discourage emigration, and the country is much in need of emigrants.

EDUCATIONAL.

The following notice has appeared recently in the public press:—The Royal Meteorological Society has during the last few years endeavoured to promote an intelligent public interest in the science of meteorology by appointing a lecturer to give information on meteorological subjects to scientific societies, institutions, and public schools in various parts of the country, and also by arranging meteorological exhibitions in connection with the Royal Agricultural Society's Show and other gatherings. The Council now desire to encourage the teaching of facts regarding weather and climate in schools, and they

are inviting elementary teachers and others to send in essays in the form of an original nature-study lesson on weather or climate (not exceeding 1500 words in length), together with a brief synopsis of five other lessons to cover the whole subject of climate and weather. If essays of sufficient merit are received, three prizes will be awarded of £5, £3, and £2 respectively. The essays are to be sent in before January 31, and addressed to Mr. William Marriott, Assistant Secretary, Royal Meteorological Society, 70 Victoria Street, London, S.W., from whom further information can be obtained.

An interesting article by Dr. C. Vallaux on "Nomadism and Emigration in Lower Brittany" in the *Revue Générale des Sciences* for September 30 may be recommended to the notice of teachers, first because of the intrinsic interest of its contents, and second because it illustrates in a very attractive way how intimate is the connection between the social, moral, and intellectual life of a people and the physical geography of their environment, and how easily these may be studied together. The particular locality studied in the paper shows many interesting analogies to the Highlands of Scotland, and like some parts of the Highlands, still retains many primitive characters. The author distinguishes between nomadism and emigration by pointing out that the emigrant always knows where he is going, even if he does not always definitely picture to himself what he is going to do in his new home. On the other hand, the nomad has a definite purpose but sets out without a definite destination in view; he seeks a locality where his special characteristics may enable him to earn his bread, not a particular locality. Starting from this definition, the author endeavours to prove that neither nomadism nor emigration is such a vague and indetermined movement as is commonly supposed. Both take place along definite lines, predetermined by the physical geography of the particular country concerned.

Looking at the peninsula of Lower Brittany as a whole, it is very evident that there is a want of balance between production and consumption, produced by a high natality combined with an infertile soil. To the west of the meridian of St. Brieuc the region is one of the most densely peopled in France (105 persons to the sq. kilometre), and yet the rocks, which are geologically ancient, like those of the Highlands, decompose to form a poor scanty soil, deficient in lime. It is, however, necessary to distinguish between two regions, the Ar-Mor or coastal belt, and the Ar-Coat or inland region. Part of the former has its hard rocks covered by alluvium, and throughout it enjoys two inestimable advantages—an abundance of valuable manure in the form of sea-weed and a peculiarly mild climate. The result is that the coastal belt is predominantly a region of market gardens, especially in the north, the production of early vegetables for the English market being a very important industry. Further, the fact that the men are largely in the naval reserve and that the fisheries are of some importance, give to the inhabitants of this region, despite its apparent poverty, a relatively great prosperity which reduces emigration to a minimum.

On passing inland, even a distance of thirty or forty kilometres, the conditions alter greatly. The climate is much more severe, the soil is poorer, and, owing to the difficulties of communication, and the perishable nature of the seaweed, this valuable fertiliser is no longer available. The people increase fast, but cultivation is backward, and the struggle for existence is severe. Here nomadism and emigration both occur, and the author shows in detail how the centres of dispersion of the people correspond to regions of specially great natural poverty. As the people of this inland region are, as it were, cut off from the sea by their more prosperous neighbours, the stream is directed rather inland to the more fertile regions of France than out to the west, like emigration in general in Europe—a curious reversal directly due to local conditions.

Looking first to the *nomads* of the Ar-Coat, we may note that there are two types—the irregular nomads, and the professional type. The former are as it were the overflow of the settlements, landless folk who wander over the country and take possession of unutilised parts of the surface. In former times much of the surface of Lower Brittany was worth so little that it was not taken possession of in any legal fashion, and the nomad squatters seized such ownerless tracts, and engaged for longer or shorter periods in minor cultivation. The crops being scanty, they frequently found marauding a more profitable occupation, and until recently were at times sufficiently well-organised in bands to make their more settled neighbours willing to pay blackmail rather than call in the aid of the distrusted State—the conditions being thus not unlike those which formerly prevailed in the Highlands. As the country becomes more settled, and methods of cultivation improve, the land is more and more definitely divided up, and this type of nomadism is in consequence decreasing.

The professional nomads belong to a different type. To understand their origin it is necessary to realise the nature of the settlements of the region. The communes are very large, and the majority of the community live outside the villages, which themselves offer few resources. Further, until recently the difficulties of communication have been great. In consequence the isolated hamlets and farms are dependent for all forms of skilled labour on wandering workmen or artisans—tailors, masons, carpenters, and so forth, who migrate from farm to farm and hamlet to hamlet. The numbers of these are gradually diminishing, but their existence was formerly of great importance in connection with Celtic literature, for it was they who carried the songs of the race from place to place.

Where prosperity is greater we find a type of temporary emigration, which does not indicate great poverty but rather a rising standard of comfort. In those parts of the peninsula where the land just barely suffices for the needs of the family, the heads of the house not infrequently seek work elsewhere during a part of the year, leaving the home to the care of the women and youths. The earnings so acquired serve to increase the yearly budget. In detail Dr. Vallaux shows the relation between centres of dispersion of this type and the nature of the soil. It is sufficient, however, for our purpose to note that this emigration is

conducted with a definite aim, and is not an indefinite wandering. Thus from the end of May to the end of July a number of Bretons are attracted to Jersey to aid in the digging of the potatoes. The worker in Jersey brings back for a month and a half of work from £6 to £8, representing for him a considerable sum. Secondly, there is a considerable emigration into Normandy, Beauce, and towards Paris for the hay and corn harvest. This emigration lasts about five or six months, and gives the worker about £12 to £16 to carry home, which may represent two-thirds of the annual income, and enables his household to pass the long winter of Brittany.

Very different is the third type of temporary emigration which takes place from Roscoff, and consists not in workers going out with empty hands to hire out their strength, but in the wandering sellers of vegetables, especially onions, who are everywhere known in England. The trade is well-organised and prosperous, and though primitive in type means prosperity and not poverty in the emigrants. The emigrants often speak English well, and their campaign of five or six months yields a net profit of some £24 per head.

It is an interesting point that though these emigrants go primarily to sell the vegetables they themselves have grown, yet they also traffic in produce bought in England and re-sold in that country—a point of much interest in connection with the evolution of commerce. But neither nomadism nor temporary emigration is sufficient to relieve the pressure of population in the poorer parts of Brittany with its usually high birth-rate—there is also a permanent type of emigration. This hardly affects the Ar-Mor at all, and therefore the emigrant Bretons are essentially country people, without any training in special trades. They are thus to be sought where there is a demand for strong arms and hard workers, and they have spread over the north, centre, and west of France, being specially abundant in Havre. Any other form of emigration is difficult for these peasants without capital or special training. At one time a considerable number were attracted to the Argentine Republic, but the discouraging reports which the pioneers sent back have checked the outflow in this direction. An effort has been made of late years to encourage emigration to Canada, but so far this has had but little success, and meantime the emigration is chiefly eastward into other parts of France.

The above may perhaps serve to suggest methods of studying the problems connected with emigration in its relation to geography in other countries.

NEW BOOKS.

EUROPE.

Grundzüge der Länderkunde. Von Dr. Alfred Hettner, Prof. der Geographie an der Universität Heidelberg. 1. Band. Europa; mit 8 Tafeln und 347 Kärtchen im Text. Leipzig: Otto Spamer, 1907. Price, paper *M.*16: bound *M.*18.

The author aims at giving a short scientific description of the lands and districts of the world for the use of teachers and students of geography and educated persons generally. The work commences with an admirable sketch of Europe as a whole, divided into three tectonic regions—the *Schollenland* of western Europe, the lowlands of eastern Europe, and the Mediterranean region, the first being again subdivided into three zones—the mountainous districts of the north of the British Islands and of the Scandinavian peninsula, a southern mountainous zone stretching from the Spanish meseta to Poland, and between them the lowlands of south-eastern England and of continental Europe. In the treatment of separate parts of the continent Dr. Hettner has found it impossible to adhere to tectonic and morphological limits. The London and Paris basins must have been grouped together, while the treatment of the Alps as a separate unity would dismember regions which are one as regards climate, vegetation, inhabitants, etc. He has therefore chosen the limits as defined by the ocean, inclosed seas and important mountain ranges. When, however, he comes to the consideration of small districts he defines their limits on the basis of tectonic and morphological conditions. There may be differences of opinion regarding this division, at any rate in individual cases, but it must be conceded that the work as a whole is extremely satisfactory.

It gives a concise outline of the physical geography, climate, vegetation, peoples, lines of traffic, etc., of Europe, in the space of one, not too bulky, volume. The due proportion of space allotted to the various sciences is well maintained, and the manner of the dependence of one on another in each region pointed out. The details as a rule have been carefully collected, though a few inaccuracies, some of them probably merely printer's errors, have crept in. The loss of Great Britain's North American colonies is ascribed to the year 1789, when the chief event in the United States was the settlement of the Constitution, while the independence of the republic was acknowledged six years earlier; again, the area of the police district of London is said to be nearly 300 qkm. (about 116 square miles) or about one-sixth of the actual. It is regrettable that Dr. Hettner insists on using the name Ofen-Pest, when not only many Germans, but almost all other peoples have agreed *magyarisch zu stammeln und Budapest zu sagen.*

The work will be completed in one more volume dealing with the other parts of the world.

Island in Vergangenheit u. Gegenwart. By Von Paul Herrmann. Teil I. Land und Leute. Teil II. Reisebericht. Leipzig: Engelmann, 1907.

Professor Herrmann undertook his journey to Iceland in 1904 at the instigation of the Prussian Education Department. His object was in the first place to collect general information about the country, and also to make and describe the journey round the south coast, which had apparently not been previously described by any German writer. His first volume aims at being a general book of reference on Icelandic matters, and will, we imagine, become a standard work on the subject. It appears to deal with every conceivable subject, and the only fault we

have to find with it is that at times the author's thoroughness seems to have led him into somewhat trivial and unnecessary detail.

To the geographer, at least, the second volume is disappointing. It is a pleasantly-written book of travel, made more interesting to the student of Folklore by extracts from sagas which describe events that took place at the spots the author visited. Physical Geography does not appear to have had its fair share of treatment, and one cannot help feeling that the author of such a work has lost a good opportunity in not presenting more fully the recent advances of knowledge of this region. This point is illustrated by the route-map, which is a very poor production. A map even on the same small scale based on Thoroddsen's and the most recent Danish surveys, with certain of the most obvious errors corrected, such as the extraordinarily incorrect delineation of the northern margin of the Vatna Jökull, would have materially heightened the value of the book.

Scottish readers will be amused at the author's generalisations on Edinburgh and its people; the impressions of a day's visit. There are unfortunately too many examples of Professor Herrmann's anglophobe tendencies which at times are strong enough to impair his judgment; some of these are quite out of place in a serious work. One cannot help wondering whether the omission of all reference to some of the latest British contributions to Icelandic Geography is not due to the same cause.

The book is well indexed, the separate index for proper names being particularly convenient.¶

Cordova, a City of the Moors. By Albert F. Calvert and Walter M. Gallichan. With 160 illustrations. London: John Lane, The Bodley Head. New York: John Lane and Co., 1907.

We have already passed in review more than one of Mr. Calvert's works on Spain, and now we welcome this charming addition to the Spanish Series. In many ways it compares favourably with some of the previous volumes. It was natural perhaps in dealing with so important a subject as Granada, that a large and sumptuous edition should have been produced, but it was cumbersome and rather overloaded with architectural illustration. The present volume is more compact, lighter to hold, more easy to pack in one's trunk, and it is eminently readable.

The history of Cordova, "the Bride of Andalusia," comprises the amazing story of the Arab occupation of Spain. In reading of the past magnificence of this unique city, one is reminded of the tales of the *Arabian Nights* in which palaces and cities spring up in the course of the night by the magic power of genii, only to be swept away by some superior spirit, leaving "not a rack behind." Where, for instance, is the city of Ez-Zahra, "the city of the fairest," which took forty years to build? Where are all the countless palaces and mosques in Cordova itself? All are gone, not a trace left except the old Bridge and the great Mosque.

The Mezquita, as it still is called, must be reckoned as the finest piece of Arab architecture extant, transcending even the Alhambra. The authors trace the decadence into which Visigothic Spain had fallen and the irresistible wave of the Arab invasion. Then is told the romantic story of Abd-er-Rahman, driven out of Damascus, and after many dangers finding his way to the gates of the city of Roderick. Like Solomon of old, when the tide of conquest and religious enthusiasm was at its height, Abd-er-Rahman called the best architects and searched the wide world for the finest materials, with the result that we have left to us a monument that has never been surpassed. We may regret with Charles v. that this wonderful fabric should have been spoiled by the intrusion

of the Christian Cathedral, but it must be remembered that but for this the entire Mezquita might have fallen into disuse and gradually been swept away.

The numerous illustrations are beyond praise. The text, indeed, is really an elaborate introduction to these beautiful photographs. The traveller who takes this volume with him will find his pleasure greatly increased.

ASIA.

The Royal Tour in India. By Stanley Reed. Bombay: The *Times* Press, 1906.

This handsome and profusely illustrated volume may be described as the official itinerary of the Prince and Princess of Wales during their tour in India and Burmah in the winter of 1905-6. From a preface written by Sir Walter Lawrence, Chief of the Staff, we learn that the work was compiled at the request of their Royal Highnesses, so that the chief incidents of the tour might be recorded in a continuous and permanent form. The task was entrusted to Mr. Reed, one of the staff of the *Times of India*, who accompanied the royal party throughout the tour. As was to be expected, the work has been very thoroughly and successfully compiled, as the compiler had exceptional opportunities of seeing and doing everything, and having had considerable experience of India, he was able to make a judicious and useful selection among the many incidents which came under his notice. For English readers he has added some historical information, which gives an additional interest to the work. It was inevitable, we suppose, that in such a work the style should often be so turgid and inflated that the weary reader longs for simpler language. Here, for example, are a few sentences taken from the description of the illumination of Bombay: "The haze was thickened by the dust raised by a million trampling feet, and as the sun sank red beneath the western sea and the myriad lamps sprang into life, it turned into molten gold, through which glowed blood-red rubies, emeralds and diamonds and amethysts. It was a town from fairyland, a sea furrowed by elfin ships, each house, each ship the perfect product of the jeweller's art." Our readers will now know what to expect from the glowing pen of Mr. Reed. The book is profusely illustrated with excellent photographs from the well-known Indian firms of Bourne and Shepherd and Deendyal and Sons. It might be rash to predict that, after the plethora of corresponding works which have been published in this country of late, this one has much chance of the success it deserves, but it is sure to be much appreciated in India.

Across Persia. By E. Crawshay Williams. With Illustrations and Maps. London: Edward Arnold, 1907. *Price* 12*s.* 6*d. net.*

Books about Persia are not wanting in these days, and that country ought not to be unknown to readers of geographical literature. The last book regarding it which we noticed—*Persia Past and Present* (cf. this *Magazine*, xxiii. p. 216)—was the elaborate and learned work of a scholar and antiquarian who visited Persia in connection with his special pursuits. By way of contrast, the present book is the work of an enthusiastic traveller of the globe-trotting type, who has some acquaintance with a variety of subjects, wrote a very detailed diary of his personal movements, experiences, and feelings during his three months' journey, and possesses an ebullient literary facility whose first display apparently is to be seen in this book. It is eminently readable, if often high-flown and sententious and occasionally trivial; is suitably illustrated, and conveys a clear, sometimes vivid, impression of the modern Persians of various social ranks, and of the country and

the notable sites and scenery lying on the route from the Persian Gulf at Bushire, by Shiraz, Isfahan, and Teheran, to the Caspian. The journey was made in 1903, and except as giving the writer's views of the Persian character generally and the social and economic condition of Persia at the time of his visit, the book contains no definite information about the recent revolution in the domestic politics of Persia, or the distribution of her territory—without, as far as appears, consultation with herself—into spheres of influence by her foreign neighbours on the north and east. Respecting the former of these topics, however, the author remarks—"Social disorder and bodily disease oppress the common welfare like some stifling cloud, while the soul of the people and the resources of the land lie alike uncared for and uncultivated." . . . "Behind the people of Persia is a long history of selfish autocracy. Around them is a state fertile in ignorance, poverty and disease. Before them are vast possibilities. . . . Persia must work out her own salvation. The rest of the world can only pray that the men and measures will be adequate thereto" (pp. 250, 256).

This is probably a fair representation of Persia's present case. Its solution may be a slow process: except in one direction—relapse—it can hardly be a rapid one.

AFRICA.

From the Niger to the Nile. By Lieutenant Boyd Alexander, Rifle Brigade. In two volumes. London: Edward Arnold, 1907. *Price* 36*s. net.*

The daring *motif* of the Alexander-Gosling expedition is stated with characteristic modesty by the author of this work, when he says in his introduction that his imagination was fired with the idea of crossing Africa from West to East by boat; and the two handsomely got up and beautifully illustrated volumes now before us contain the record of how this extraordinary feat was accomplished, and with what results—and, we must add, at what cost. The original objective in Mr. Boyd Alexander's mind was a thoroughly scientific survey and comprehensive investigation of Lake Chad, its inhabitants, flora, fauna, fish, etc., but to this comparatively limited project there were speedily added the survey of the little-known territories from the Benue to Lake Chad, and an attempt to reach the Nile by the Shari, Ubangui, Welle, and Kibali rivers. For such a complicated and difficult expedition coadjutors were necessary, and Mr. Boyd Alexander was more than fortunate in finding his own brother, Captain Claud Alexander of the Scots Guards, and Captain Gosling, a brother officer of the Rifle Brigade, both able and willing to join him. The former had had much experience in survey work; the latter was a mighty hunter and field naturalist, and both unfortunately had to pay the extreme penalty of their devotion to science and love of adventure, for they succumbed, the former to enteric, and the latter to blackwater fever, in the course of the expedition. The fourth member of the expedition was Mr. Talbot, a surveyor. The fact that Mr. Boyd Alexander has addressed the members of this Society at headquarters and at all the branches, and has also been good enough to publish his lecture in this number of the *Magazine*, renders it unnecessary for us to give any *résumé* of the varied contents of this book. But we desire to impress on our readers that a mere perusal of the paper—and even the hearing of the lecture cannot give them anything like an adequate conception of the contents of this work, every chapter of which has an interest of its own, sometimes scientific, sometimes adventurous, sometimes humorous, and sometimes intensely pathetic. The Alexander-Gosling expedition was more than successful in accomplishing what the gallant and daring projectors decided to attempt. The country between

the Benue and Lake Chad was surveyed and mapped, and considerable additions were made to our knowledge of the geographical conditions of Northern Nigeria and its inhabitants. Lake Chad and its vicinity were scientifically explored and mapped, with the remarkable result that we must now understand that Lake Chad is not one lake but two. The Bamingi, Kibali, and Yei rivers were explored and mapped. In the department of Natural History specimens of several new species of animals and birds were secured, and a collection of Lake Chad fish was secured which shows that they are identical with the fish of the Nile. Besides these substantial additions to our geographical and scientific knowledge, the volumes disclose many interesting and new facts and observations regarding the appearance, habits, customs, ceremonies, religions, beliefs, affinities and languages of the numerous tribes and peoples met with in the course of the 6000 miles through which the expedition passed. Not the least interesting, and at any rate at the present juncture not the least important, feature of the work, is the cordial testimony it bears to the skilful, judicious, and successful administration of the French, Germans, and Belgians in the wild and barbarous territories and communities of Central Africa which these nations now govern. Mr. Boyd Alexander, who will be readily admitted to be an impartial, competent, and experienced eye-witness, has rendered good service to the cause of humanity and justice, and to that of the general *entente cordiale*, when he says that "having regard to their knowledge of the country, their control of the natives and the condition of the tribes that come under it, the discipline of their soldiers, the finely-built stations and excellent transport arrangements, it is my opinion that the opening up of the Congo places the Belgians in the front rank of colonisers."

It would be easy to expand this review with eulogiums of the patient courage, the fertility of resource, the tenacity of purpose, the steadfast tranquillity under most distressing conditions, the manly demeanour and unselfish devotion of every member of the expedition in the midst of multiform trials and dangers, during no less than two and three-quarter years of arduous physical and mental strain between March 1904 and December 1906, and illustrations could be found in every chapter. We are all the more tempted to dilate on this subject, as nothing was more noticeable in his lecture than the moderation with which Mr. Boyd Alexander referred to his own exploits and to those of his gallant companions. But we content ourselves with referring our readers to the pages of this very remarkable narrative, in which they will find abundant evidence that the days of marvellous adventure and disinterested and even affectionate *camaraderie* in African travel are by no means over. One of the most striking and charming features of the book is, that it shows us how gentle and kind, as well as how judicious and firm, were the relations Mr. Boyd Alexander established and maintained between himself and his followers, to whose welfare he paid constant attention, and whose limitations he knew well. We must add that the author is master of a clear, simple, and incisive style; he makes no attempt whatsoever at fine writing; the story he has to relate has no need of such adventitious effects to make it interesting; but at times compelled by the grandeur or, it may be, by the pathos of his subject, he rises into passages of true eloquence. The numerous photographs which illustrate the work give us excellent representations of typical scenery and inhabitants; some of these are, by the courtesy of the publisher, reproduced in our present issue. There are also several exceptionally good maps, to which we recommend constant reference during a perusal of the work, if our readers desire to understand rightly something of the arduous nature of the enterprise which was so bravely undertaken and successfully carried through by Mr. Boyd Alexander and his accomplished companions.

The Truth about the Congo. By Professor Frederick Starr. Chicago: Forbes and Co., 1907.

The vast Congo territory has been a fiery centre of interest during the past few years. Its administration by the representatives of the Belgian king has been gravely questioned. The welfare of the natives, which was proclaimed as the prime motive of Leopold's undertaking, seemed to have been lost in the passionate desire to exploit the country for the enrichment of its rulers. Professor Starr asserts that he can tell *The Truth about the Congo*, and the truth amounts to this, that the Belgian king and his people have done great things for the Congo, that the atrocities are things of the past, that some things might be better, but on the whole, France, Britain, and even the United States have drunk the same cup of iniquity as Belgium in respect to their dealings with natives in uncivilised regions. He spent a year in the country, travelling 7000 miles, and visiting twenty-eight different tribes. But the truth he tells, though he palliates the evils as much as possible, is sufficiently dark to afford strong ground for those who complained of the sufferings to which the hapless Congolese were subjected. The Kwaga tax, by which the natives have to provide so much bread, and to travel days upon days to bring it in, leaving scarcely time to prepare it, when they must trudge off again, is simply a species of refined cruelty. The author's position may be realised by his statement that Britain's whole interest in the agitation for reform is political and selfish. On one page, further, he announces his ineradicable belief that all native peoples should be left to work out their own destiny, and in the next that in the Congo they had harried and massacred each other till populous places had become a wilderness. But the burden of his plea is to restrain the President of the United States from doing anything for the cause of Congo reform. (The articles appeared first in the *Chicago Tribune*.)

Stanford's Compendium of Geography and Travel. New Issue. Africa: Vol. I. North Africa. By A. H. Keane. Second edition. Revised. London: Edward Stanford, 1907.

Mr. Keane's new volume will be welcomed by all those—and they are an increasing number—who take an interest in the study of our earth and its races, in geography in its wider aspect, and who are mindful of the imperial position and responsibilities of their country. The book will not only serve as a guide to the professed student, but will stimulate thought in every intelligent reader.

The present volume deals with North Africa, and though the division-line between the northern and southern parts of the continent is not so marked to the eye as when the Mountains of the Moon appeared in the atlas as a wall of partition, yet the contrast is sufficiently distinct. That which lies to the north of a line drawn from the Gulf of Guinea to Cape Guardafui differs from that which lies to the south in height, for South Africa is from two to three times as high as North Africa; in water-system, for the great lakes and almost all the navigable rivers belong to the south—the most marked exceptions being the Niger and the Benue, the latter of which might long ago have given access to the heart of the continent; in population, for the south is mainly inhabited by the Negroid Bantus, while in the north there are at least three distinct stocks.

In the extreme north there are probable traces of some prehistoric race in the great cromlechs and monoliths. But whoever these builders may have been, they have been absorbed by the advancing stream of migration: first came the Hamite or Berber, then the Phœnician or Semite, while the Sudan has always

been true to its name as the "Land of the Blacks." The past ages of most of the "Dark Continent" are shrouded in mystery, but of the Mediterranean seaboard we have a fairly clear historical record. To the Phœnician succeeded the Roman occupation when "Africa" became "the common granary of Rome and of mankind"; then came evil days, the lordship and misrule of the Vandals (B.C. 429-534), the conquests of Belisarius, which transferred the control of the northern coasts to the Eastern Empire and to the taxation and oppression which seem to have been the primal cause of the misery and barbarism from which these regions are only now beginning to emerge. In the seventh and again in the eleventh century came the Moslem Arab invaders, but though the Berbers were driven to the uplands, assimilation between two races that were originally of kindred stock ensued; to this day we find the tribal system both among Berbers and Arabs, among the former democratic like the Russian "Mir," among the Arabs patriarchal and monarchical resembling the Irish sept and Highland clan.

Passing southward we approach the Sahara or Sahra, the waste, through the region where the most serious power is the Senûsiya Brotherhood under its Mahdi, which, although only fifty years old, is expanding along the borders of the Anglo-Egyptian Sudan, and aiming at the restoration of the power of Islam. The Sahara itself is evidently not an ancient marine basin capable of being transformed again into an inland sea, but is a plateau of diversified structure the most outstanding feature of which is Tibesti, a mountain system 430 miles long, and as far as we yet know some 60 miles in thickness. This vast plateau of the Sahara, originally more that 3000 feet in height, has been worn down by denudation, due mainly to the great variation of 100° F. between the day and night temperature, to its present height of 1400 feet and is characterised by its superficial dryness. The water-courses continue to flow underground so that water is found where wells are sunk, but across its extent there is not a mile of navigable water, not a track even for the caravans which, since the time of the Arab invaders, have interchanged the commodities of the Sudan with those of Europe. The west of the Sahara is mainly occupied by Arabs, the centre by Berbers, or as they call themselves Imoshagh (the free), or as they are sometimes called Tawârek, the east by the kindred Berber stock of the Tibu, while yet to the extreme east stretches the Libyan Desert, a vast sea of sand, shingle, and grit.

More interesting still is the Sudan with its expanse of 3500 miles by 600, the "Home of the Blacks." This may be divided geographically into the West Sudan or the basin of the Niger and the Benue, the Central Sudan or the region round Lake Chad, and the Eastern Sudan or the Land of Rivers, prominent among which the Bahr-el-Ghazal brings down a mass of "sudd" or tangled floating vegetation to the White Nile. The main population of the Western Sudan may be said to be Negro, and is now under the political influence of France or of Britain: that of the Central Sudan is Negroid, and is now under the political influence of Britain, France, or Germany. It is here that our countrymen have done some of their best civilising work; it is no slight tribute to British rule to find that in two years and a half, between the middle of 1903 and the end of 1905, Bornu has been brought under the sway of order and "slave-raiding become a thing of the past." In the east of the Sudan the ruling race is Arab: this country was the scene of the great Mahdist uprising of 1883 to 1898, which is traced to two main causes, to the alarm and anger of the fanatical Mohammedan Arabs at the changes threatening in Egypt and the probable extinction of the slave-trade, and to the oppression exercised by the Egyptian governors in the remote provinces of the Bahr-el-Ghazal.

"The best hope for the Sudan," with its teeming population of eighty millions, "is to be found neither in the Arabs who, especially in the east, are the disturbing element, without whom there would be no fanaticism, no slave-hunters, no Mahdis, no Egyptian question"; nor in the indolent unintelligent Negroes, but in "the mixed Negroid peoples who are really capable under European guidance of moral and material progress."

Space imposes a limit on our notice of this illuminating book. We would only in conclusion draw attention to two pregnant judgments. The first is on the attempt of the Italians to found a north-east African empire: the issue of this attempt, apparently disastrous, "promises hope to Italy if she perseveres with prudence and firmness and moderation on the path"—of settlement, agriculture, and commerce—"which she has begun, while Abyssinia will profit still more, though there be an end to the proud dream of an independent kingdom of all Abyssinia." The other has reference to the progress which the present generation is seeing in Egypt and the Eastern Sudan: "All this material progress is absolutely dependent on the stability of the political situation which, humanly speaking, can only be maintained by a permanent British occupation of the Nile Valley."

AMERICA.

Sunshine and Sport in Florida and the West Indies. By F. G. Aflalo. London: T. Werner Laurie, 1907. *Price* 16*s. net.*

This volume is mainly an account of a shooting trip to Florida, undertaken for the purpose of tarpon fishing, but as the author was in the vicinity, as it were, he took the opportunity of paying a flying visit to some of the islands of the Spanish Main, as well as to Panama.

Being a shrewd observer of men and things, and likewise gifted with a pleasingly sarcastic humour, Mr. Aflalo has produced a series of very diverting sketches of the places visited.

As to the tarpon fishing, it is described with a minuteness of detail enough to satisfy the most ardent fisher; and any one desirous of killing tarpon, and having the leisure and the wherewithal—for tarpon-fishing is an expensive pastime—will find all the information on the subject he could wish in Mr. Aflalo's pages. We doubt, however, if the game is worth the trouble and expense, and we have a suspicion that the author is somewhat similarly minded; anyhow, he is too good a sportsman not to admit that, monster as the tarpon is, he has no chance against the mighty tackle employed for his capture.

AUSTRALASIA.

In the Strange South Seas. By Beatrice Grimshaw. London: Hutchinson and Co., 1907. *Price* 16*s. net.*

The title of this amusing and well-illustrated book is somewhat misleading, as Miss Grimshaw, who is already favourably known as the authoress of *From Fiji to the Cannibal Islands*, did not, on this occasion, wander into unknown regions. Starting from Liverpool she visited Tahiti in the Society group, and thence went on to Baratonga and several other islands of the Harvey group. From thence she made her way to Savage Island and others of the Samoan group, and passed on to the famous guano island of Malden some four degrees south of the Equator. From Malden she sailed to the Manahiki group, and thence to the Friendly Islands and the Samoan group, and thence to New Zealand. The last two

chapters are devoted to a description of the Hot-Water country. It is needless to assure our readers that Miss Grimshaw's narrative of her adventures and wanderings is always amusing, and that the interest never flags. She soon and invariably established the most friendly relations with the natives wherever she went, and more particularly with those of her own sex, and she would be the first to admit that she presents them to her readers in as attractive and favourable a light as possible. Her anecdotes and experiences are instructive as well as interesting. In these days of emigration and search for new fields of employment some may be tempted to turn their attention to the islands of Oceania, where, according to tradition, life is easy and happy; one need not even "tickle the soil," as nature supplies abundance of food with a lavish hand. To the would-be emigrant to Oceania Miss Grimshaw offers some wise advice and kindly warning. "At the present date young Englishmen by the hundred are losing their small capital as 'pupils' on Canadian farms, or are starving on the roads in South Africa, while all the time the South Sea Islands hold out hands of peace and plenty, begging humbly for a respectable white population. The brown races are dying out with fearful rapidity; at their best they never touched the limitless capacities of the golden Pacific soil. Now, however, when so many groups of fertile islands have fallen into the hands of more progressive nations, things are changed. The white man can live happily and healthily in the Pacific: he can obtain a good return for a small capital at the best, and at the worst cannot possibly suffer from either cold or hunger, since neither exists in the South Seas." This may be true, but to a Briton of average energy and capacity life in the Pacific resembles too much the life of the lotos-eaters of Tennyson, and we fear the day is still far off when emigration to Tahiti will be as popular or as wholesome as emigration to Canada or Argentina.

GENERAL.

Hindustani Grammar. By Captain C. A. THIMM. Second edition, revised.

Japanese Self-Taught. Edited by W. J. S. SHAND.

Tamil Self-Taught. By Don M. DE ZILVA WICKREMASINGHE. (Marlborough's Self-Taught Series.) London: Marlborough and Co., 1907. *Price 2s. 6d. each.*

These useful little books may be recommended to the special notice of the persons interested. The value of the Hindustani volume is indicated by the fact that it has passed into a second edition, in which several improvements have been made.

I Vulcani Attivi Della Terra. Morfologia-Dinamismo-Prodotti-Distribuzione-Geografica-Cause. By G. MERCALLI. Milano: Ulrico Hoepli, Editore Libraio della Real Casa, 1907.

The subterranean forces of the earth have of late years been making themselves felt with such terrible emphasis that an authoritative work dealing with volcanoes will be read with more than usual interest. Signor Mercalli looks to the time when science will enable observers to foretell eruptions, and, if not to save property, at any rate to minimise loss of life, and in this connection he suggests that such observation would be on the lines of micro-seismic auscultation. When it is considered how little is *positively* known, it will be seen what a field there is for scientific research, even although, as Mercalli observes with some humour, "the violence of the phenomena often takes away the calm which is necessary for scientific observation." The ninth chapter dealing with the causes of volcanic

phenomena will attract special notice. What is the probable condition of the interior of the earth, whence does it derive its heat?

Signor Mercalli dismisses, as indeed has been done before, the idea that the earth is composed of a fiery liquid centre covered by a thin shell. He considers that there are large reservoirs containing the semi-liquid material, such reservoir being entirely shut off from any other source, being limited in capacity and exhaustible in the course of time. Any one reservoir rarely lasts beyond the geological period in which it commences, but tends to become extinct. What causes the phenomena which lead to eruption and earthquake? The author thinks we must look to sea water as being a determining agent. This, finding its way into the reservoirs, causes oxidation of the metallic substances, and in this way the gases which are found in the vapour are produced. This subject he goes into at great length. Again, he is of opinion that the cause of the heat is largely chemical, an effect of the oxidation already mentioned. It is partly due to the original telluric heat, largely to chemical, and to a certain extent to mechanical causes.

The historical allusions to the destruction of Pompeii and Herculaneum are also very interesting. It was considered that Vesuvius was absolutely extinct, so long had it been since any manifestation had taken place. But when the eruption did occur, the warnings were so unmistakable that nearly every one escaped except those who hid themselves in the basements of their houses, hoping that the fall of ashes would not be very severe.

The photographs illustrative of the text are both numerous and excellent.

Over-Sea Britain. By E. F. Knight. London: John Murray, 1907. *Price* 6*s. net.*

This is unquestionably an ambitious as well as an useful work. The author—well-known to the public as the writer of *Where Three Empires Meet*—describes it as "a descriptive record of the geography, the historical, ethnological, and political development, and the economic resources of the Empire." We gather from the preface that a second volume is to be devoted to the British possessions in Asia and Oceania, and the volume now before us deals only with the nearer Empire, viz. the Mediterranean, British America, and British Africa. When we mention that the volume contains only some three hundred pages, it is evident that it can contain only condensed sketches, conveying in an eminently readable form an immense amount of information, which, however, can easily be got from other sources. The historical part of the work is fairly up to date—for example, in treating of Egypt mention is made of so recent an event as the resignation of Earl Cromer. The volume is also equipped with several useful maps, and may be recommended as an easy book of reference.

BOOKS RECEIVED.

We have received the following new books, which will be reviewed in due course:—

The Pulse of Asia: A Journey in Central Asia illustrating the Geographical Basis of History. By Ellsworth Huntington. Illustrated. Demy 8vo. Pp. xxi+415. London: Archibald Constable and Co., 1907. *Price* 14*s. net.*

A Holiday in the Happy Valley with Pen and Pencil. By T. R. Swinburne, Major (late) R.M.A. Illustrated. Demy 8vo. Pp. xii+342. London: Smith, Elder and Co., 1907. *Price* 16*s. net.*

History of the Incas, by Pedro de Gamboa; and *The Execution of the Inca Tupac Amara*, by Captain Baltasar de Ocampo. Translated and edited by Sir Clements Markham, K.C.B. Demy 8vo. Pp. xxii + 395. Hakluyt Society, 1907.

The Travels of Peter Mundy in Europe and Asia, 1608-1667. Vol. I., Travels in Europe, 1608-1628. Edited by Lieut.-Col. Sir Richard C. Temple, Bart., C.I.E. Demy 8vo. Pp. lxiv + 284. Hakluyt Society, 1907.

Traité de Géologie: Les Phénomènes Géologiques. Par Émile Haug. Un vol in 8°. Pp. 546. Paris: Armand Colin, 1907. *Prix* 12*fr.* 50.

Guide to South Africa for the use of Tourists, Sportsmen, Invalids, and Settlers. Edited by A. S. Brown and G. G. Brown. 1907-1908 Edition. London: Sampson, Low and Co., 1907. *Price* 2*s.* 6*d.*

Ferdinand von Richthofen's Tagebücher aus China. Ausgewählt und herausgegeben von E. Tiessen. 2 Vols. Band I., pp. xiv + 588; Band II., pp. 375. Berlin: Dietrich Reimer (Ernst Vohsen), 1907. *Preis* 20*m.*

Publishers forwarding books for review will greatly oblige by marking the **price** *in clear figures, especially in the case of foreign books.*

NEW MAPS.

EUROPE.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st October 1907:—One-inch Map (third edition, engraved, in outline).—Sheet 49. Price 1s. 6d. Third edition, printed in colours and folded in cover, or flat in sheets. *North Berwick*, Sheet 41. Price, on paper 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d.

Six-inch and larger Scale Maps. Six-inch Maps (revised) full sheets, heliozincographed, with contours. *Caithness.*—Sheets 5, 7, 8, 19; price 2s. 6d. each. Sheets 14, 20; price 2s. each. Without contours. *Caithness.*—Sheet 16; price 2s. 6d. Full Sheets, engraved, without contours. *Sutherland.*—Sheets 31, 37, 38, 47, 57, 58, 67, 78, 89; price 2s. 6d. each. Sheets 21, 68; price 2s each.

1 : 2500 Scale Maps (Revised) with Houses stippled, and with Areas. Price 3s. each. *Berwickshire.*—Sheets vii. 15; xiii. 6. (Sheet xiiia. 12 and xiii. 13). Price 1s. 6d. *Edinburghshire.*—Sheets iva. 13; viii. 8, 13, 14, 15, 16; xiv. 3; xv. 1, 2, 8, 10, 12. *Haddingtonshire.*—Sheets ii. 11; iii. 9, 10, 14; iv. 4, 8; v. 3, 4, 7, 9, 10, 11, 12, 13, 14, 15; vi. 1, 2 (3 and 4), 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16; ix. 1, 5, 9, 13; x. 1, 2, 3, 5, 7, 8, 9, 10, 11, 13; xiv. 2; xv. 2, 8; xvi. 1, 2, 4, 5, 9; xviii. 2, 8, 12.

Note.—There is no coloured edition of these sheets, and the unrevised impressions are withdrawn from sale.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 30th November 1907:—One-inch Map (third edition), engraved, in outline. Sheet 42 and 50. Price 1s. 6d. Third edition, engraved, with hills in brown or black. Sheets 37, 49. Price 1s. 6d. each.

Six-inch and larger Scale Maps.

1 : 2500 Scale Maps (Revised), with Houses stippled, and with Areas. Price 3s. each. *Berwickshire.*—Sheets i. 10, 11; vii. 16; ix. 2, 3, 6, 10, 11, 14; xiii. 2, 3, 4, 5, 9, 10; xx. 8, 10. Sheets xiiia. 8; xix. (10 and 14). Price 1s. 6d. each. *Edinburghshire.*—Sheets iv. 8, 12, 16; viii. 4, 5, 6, 7, 10, 11, 12; ix. 1.

Haddingtonshire.—Sheets III. 13; IV. 7 and 3; V. 8, 16; VI. 11; VII. 5, 9, 10 (11 and 16), 13, 14, 15; VIII. 8, 12, 16; X. 4, 6, 12, 14, 15, 16; XI. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14; XII. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14; XIII. (5 and 9); XIV. 1; XVI. 16; XVII. 5, 9, 13, 14, 15. Sheet XXI. (1 and 2). Price 1s. 6d.

Note.—There is no coloured edition of these sheets, and the unrevised impressions are withdrawn from sale.

GEOLOGICAL SURVEY OF SCOTLAND.—The following publications were issued, 7th December 1907.

Six-inch maps, Quarter Sheets, uncoloured. Price 1s. 6d. each. *Edinburghshire.*—3 NE., 3 SE., 12 SE. *Haddingtonshire.*—4 SW., 4 SE.

ADMIRALTY CHARTS, SCOTLAND.—**Sound of Mull**, Eastern Portion. Surveyed by Captain W. F. Maxwell, R.N., 1904-5. Scale 1 : 24,395. Published October 1907. Number 3607 (3703). Price 3s. **Isle of Skye**, Uig Bay. Surveyed by Captain Morris N. Smyth, R.N., in H.M. surveying ship *Research*, 1906. Scale 1 : 10,600. Published October 1907. Number 3669 (3706). Price 2s.

Presented by the Hydrographer, The Admiralty, London.

LONDON AND SUBURBS.—Bartholomew's Handy Reference Atlas of ——. From latest surveys, showing street names as altered by London County Council. With complete index to streets, public buildings, etc. By J. G. Bartholomew, F.R.G.S. Price 2s. 6d. in cloth, and 3s. 6d. half morocco.

John Bartholomew and Co., Edinburgh.

This new atlas of London consists of sixty-four maps giving the whole area of the County of London, mostly on a scale of $3\frac{1}{4}$ inches to a mile, a scale sufficiently large to show clearly the names of all the streets and public buildings. The index to streets and public buildings contains over 20,000 entries.

AFRICA.

CENTRAL AND SOUTH AFRICA.—By J. G. Bartholomew, F.R.G.S. Scale 1 : 5,000,000 or 75 miles to an inch. With inset plans of Cape Town, Port Elizabeth, East London, Durban, and Lourenço Marques. 1907. Price 2s. paper, 3s. mounted on cloth.

John Bartholomew and Co., Edinburgh.

This is a new map drawn from the latest surveys and coloured politically.

SOUTH AFRICA.—Bartholomew's Reduced Survey Map of ——. Coloured to show height of land, also political boundaries. Scale 1 : 2,500,000 or 39 miles to an inch. With inset plans of Cape Town, Port Elizabeth, and Durban. 1907. Price 2s. paper, 3s. mounted on cloth.

John Bartholomew and Co., Edinburgh.

This new edition is carefully revised to date and inset plans have been added.

GOLD COAST.—Map published by the authority of Sir John P. Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1 : 125,000 or about two miles to an inch. Sheets—72 L III., Kibbi; 72 L IV., Komfrodua; 72 Q IV., Cape Coast; 72 R I., Nsaba; 72 R III. and IV., Winneba and Nianyano. 1907. Price 2s. each sheet. *W. and A. K. Johnston, Ltd., Edinburgh and London.*

This is a farther instalment of sheets of this important new map.

BRITISH EAST AFRICA.—Reconnaissance Map of Lambwa and Sotik. Scale 1 : 250,000, or about four miles to an inch. Price 2s.
Topographical Section, General Staff, London.

AMERICA.

DOMINION OF CANADA.—Railway Map on scale of 1 : 6,336,000, or 100 miles to an inch. James White, F.R.G.S., Geographer. 1907.
Department of the Interior, Ottawa.

A useful general map showing the principal railway lines in operation and projected, coloured according to the different systems.

MANITOBA, SASKATCHEWAN, and ALBERTA.—General map on scale of 1 : 792,000 or 12½ miles to an inch. Three sheets. James White, F.R.G.S., Geographer. 1907. *Department of the Interior, Ottawa.*

A valuable map showing many additions to our topographical knowledge of these Provinces. The addition of contour lines printed in brown is an important feature in such a survey.

NOVA SCOTIA.—Standard Topographical Map. Scale 1 : 250,000, or about four miles to an inch. Cape Breton Sheet. James White, F.R.G.S., Geographer. 1907. *Department of the Interior, Ottawa.*

The sheets of this beautiful map are such a welcome addition to the surveys of the Empire that it is a pity its publication cannot be further accelerated.

SOUTHERN ALBERTA AND SOUTHERN SASKATCHEWAN.—Maps showing Electoral Divisions according to the Representation Act of 1906. Scale 1 : 792,000, or 12½ miles to an inch. James White, F.R.G.S., Geographer, 1907.
Department of the Interior, Ottawa.

GENERAL.

WORLD. GLOBUS-KARTE.—Weltkarte in Teilkarten in einheitlichen Flachenmassstabe 1 : 74,000,000, mit einer Statistischen Tabelle der selbständigen Staaten und der deutschen Kolonien, entworfen und herausgegeben von Sipman, Hauptmann und Mitglied des Ingenieur-Komitees. 1907. Preis 1 Mark. *Dietrich Reimer (Ernst Vohsen), Berlin.*

This equal-area map of the world presents the effect of the gores of a globe before they are joined up on the sphere. As a map of the world it is too much broken up into sections to be useful for most purposes, but it affords an interesting lesson on the problem of world projection. The accompanying set of tables gives in a most systematic manner the geographical statistics of the various states of the world.

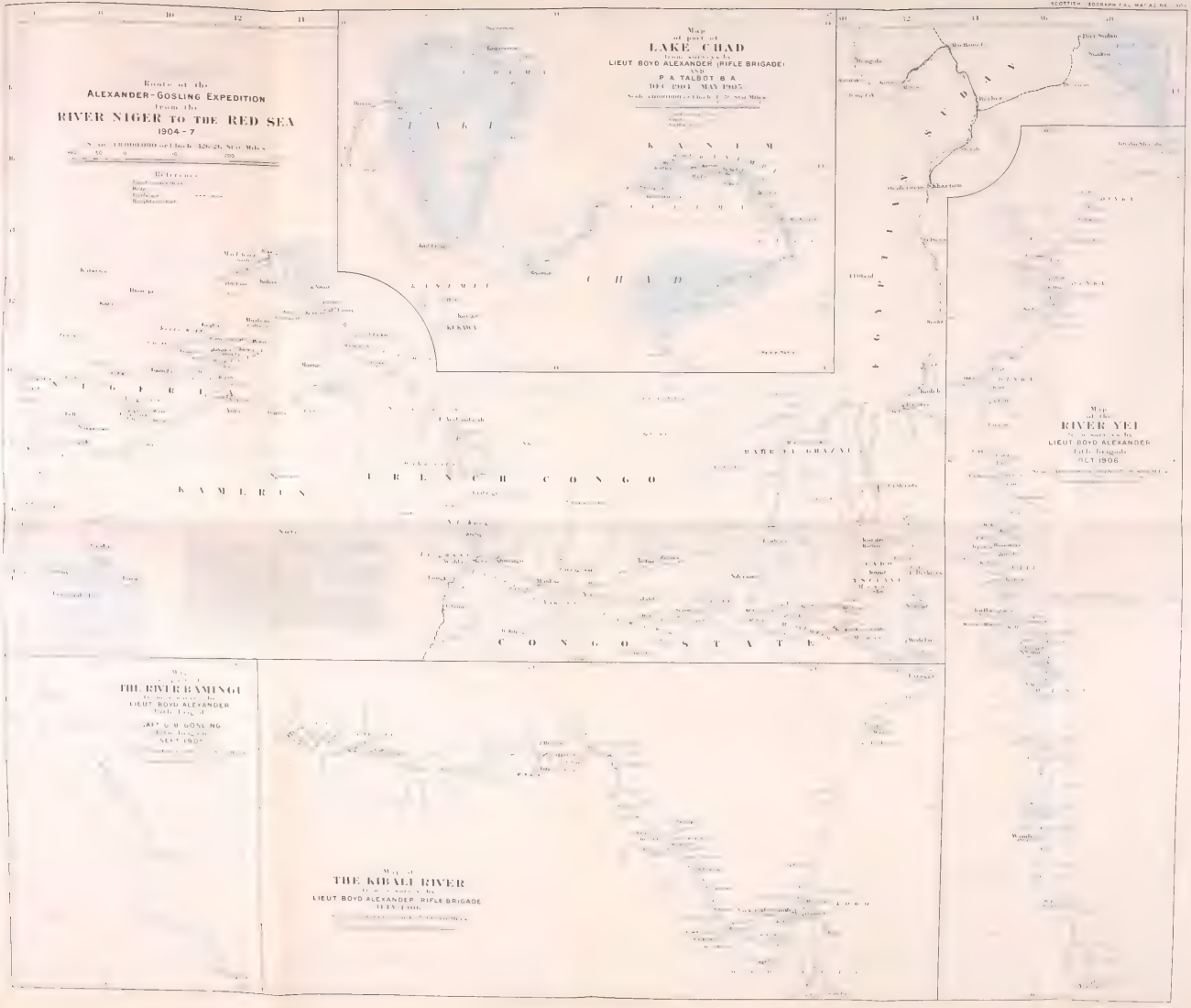
L'ANNÉE CARTOGRAPHIQUE.—Dix-septième Année. Dressé et rédigé sous la direction de F. Schrader. Octobre 1907. Prix 3 francs.
Librairie Hachette et Cie., Paris.

This issue contains the principal geographical and political changes for 1906. The three folio sheets of maps, with descriptive text printed on the back, are devoted to explorations and new boundaries in Asia, Africa, and America.

Map of the Nun-Kun Massif and Surrounding Region explored by the Bullock-Workman Expedition in 1906

Compiled from personal observation and photographs adapted to survey sheet 45 S.W.

SCOTTISH GEOGRAPHICAL MAGAZINE



THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE EVOLUTION OF THE CROWN COLONY OF MAURITIUS.[1]

By Sir Charles Bruce, G.C.M.G.

(*With Illustrations.*)

Some years ago Sir Hubert Jerningham, my predecessor in the Government of Mauritius, wrote of the colony in these words:—"Among the dependencies of the British Crown there is one which, inconsiderable in extent and almost shut out of notice by its distance from great commercial centres, and the absence within its territory of those mineral attractions which at once give prominence to a country, yet asserts its claim to attention in a manner peculiarly its own, and defies the history of the world to forget its existence in the development of race, in the stubbornness of man struggling against adverse odds, and in the remarkably recuperative powers with which it is endowed."

I propose to show how centuries of struggle have developed in Mauritius a population appropriate to its environment, as evidenced by the recuperative powers it has displayed, and have given such considerable importance to an area of territory rather smaller than the county of Surrey.

The Portuguese in Cerné.—The island now called Mauritius was discovered and named Cerné by the Portuguese pilot Diego Fernandez Pereira on the 7th of February 1507, so that the task I have undertaken may be considered appropriate to the close of the fourth centenary year of the discovery. There is no record of any Portuguese settlement in the island. It served as a refuge in stress of weather, and as a point of call for fresh water and such original supplies as it afforded, supplemented by the natural but untended increase of introduced plants and animals, such as deer, goats, and pigs. From the first ships landed no

[1] An Address delivered before the Society in Edinburgh on January 16, 1908.

doubt the first rats. These rodents have proved to be the only really formidable enemies of the human race in the fauna of the island. They have devoured every green herb introduced for the service of man; the attempt to displace them has cost sums that must have aggregated hundreds of thousands of pounds; and they have been the chief carrying agents in the propagation of bubonic plague.

Beyond serving as a point of call, Cerné played no part in the enterprises which for a period raised Portugal to the first rank among maritime powers, and gave her a practical monopoly of sea-borne Indian commerce. It was the struggle of the nations of Europe for the key of the Indian Ocean when the power of Portugal had failed that was to determine its strategic and economic value.

The Dutch in Mauritius.—When on the 18th of September 1598, the Dutch Admiral Wybrand van Warwyck found a convenient harbour on the south-east coast of the island known to him as Cerné, he entered it with caution, believing the Portuguese to be in possession. But landing and boating parties discovered no trace of human habitation, and after a few days he annexed the island to Holland, giving it the name of Mauritius, after the then Stadtholder, Count Maurice of Nassau. To the harbour he gave his own name.

In the SE. Harbour.—Prince Roland Bonaparte's work, *Le premier établissement des Néerlandais à Maurice*, preserves an interesting record of the occasion in two early engravings. However primitive may seem the art of these engravings, they are of singular historic value. The first gives a chart of the harbour which comparison with the latest admiralty chart shows to be remarkably correct. A small island with the trunk of a tree erected on it as a beacon, to the right of the channel, is the Ile de la Passe, destined to become famous in the history of the colony. The landscape, if rude in design, gives a general idea of the peaks, plateaux, and passes typical of the scenery of the island. The second engraving illustrates the earliest recorded stage of the racial, political, and economic evolution of the island. The arms of Holland, Zealand, and Amsterdam, with the legend "Christianos Reformados," and the pastor "returning thanks to Almighty God for having conducted them to so fair and secure a harbour," represent the spirit which has always associated Dutch enterprise with religion; while carpenters, blacksmiths, and coopers are seen carrying on the crafts

Fig. 1.—The Peak of Pieter Both.

of the shipping trade. Of special interest is the representation of animal life—including the extinct bird, the Dodo, which has been the subject of much learned discussion, and the turtle.

In Fort Hendrik.—For forty years the Dutch continued to make use of Mauritius only as Cerné had been used by the Portuguese, as a point of call for repair and supply, adding to its economic resources by the introduction of useful plants and fruit trees and live stock.[1] It was not till the year 1638 that they decided to support the validity of their title by settlement. On the 7th of May they again took formal possession, "by planting an oar in the ground," and commenced the construction of a fort, subsequently called Fort Hendrik. It was equipped with an armament of four 3-pounder guns, and the little community of twenty-five persons left within it contained the rudiments of a political system, under the central administration of the Dutch East India Company; military and civil Government were represented by the commander, three officers, and nine soldiers; religion by the pastor; in the general population of eleven working-men, science was represented by the barber, "provided with everything in the way of medicines and instruments." Later in the year the community was strengthened by a reinforcement of thirty men landed from a man-of-war, but the Governor decided that it was never to exceed eighty residents. The duties assigned to it were to prevent any concurrent settlement by a foreign power, and to develop the resources of the island with a view, in the first place, to making it self-supporting, and then to enlarge the area of commerce, at the time limited to the export of ebony and a little ambergris. The difficulty of maintaining a monopoly of occupation soon made itself felt. The Dutch settlement had anticipated by only a few months English and French expeditions sent out with the same object, and these, while admitting the priority of the Dutch, easily accommodated themselves to it by the discovery of other landing-places, and in particular of a harbour much superior for their purposes on the north-west coast.

Struggle for Existence. — The correspondence published in Prince Roland Bonaparte's interesting monograph proves how soon the Dutch realised the inadequacy of their resources to defend the monopoly they claimed, and learned that the tenure of Mauritius is inseparable from the tenure of maritime supremacy in the Indian Ocean.[2] Within six years

[1] In January 1606, Admiral de Ionge reported: "Our people planted seven or eight orange trees and sowed grain all about. They also made a little garden near a stream, and planted cotton and fruit trees. If they are not devoured by the rats, which are very numerous, it may be hoped that they will succeed in this climate."

[2] The French vessel, *Saint Alexis*, with a crew of eighty-five, and twenty-two guns, left Dieppe on 15th January 1638. The journal of a passenger, after recording the vessel's arrival with the intention of occupying the island, continues: "Having entered the harbour between the South and East, we found the place taken by the Dutch, who were building a fort, having long before given the island the name of Prince Maurice. . . . We left this harbour the next day and went to anchor at the other end of the island, to the north-west. This harbour was guarded by six Dutchmen, quartered in some neighbouring huts. There was an English ship at anchor carrying 28 guns. . . . The people on it offered to help us to drive out the Dutch, to which we refused to consent on account of our alliance with them."

they abandoned the enterprise, but resumed possession in 1650, only again to abandon it in four years. In 1659, convinced that Mauritius commanded the sea-route of commerce between Europe and Asia, they once more undertook the work of colonisation, with a tenacity characteristic of their race and a scientific knowledge of agricultural methods at least equal to that of any other European power of the day.

The Labour Question.—But a new factor—the Labour Question—had now to be taken into account in their enterprise. At the outset of their occupation they had undertaken to provide a labouring population by the importation of natives of Madagascar under the system of slavery, then universally recognised as the only appropriate agency of tropical labour. This agency was now supplemented by the introduction of convicts from Batavia, and thus an uninhabited island was artificially provided with a population perhaps more hostile to the colonising power than any native population that has resisted European colonisation in any area of America or Asia. It was not long before the facility of escape, from the isolated stations where the Dutch had commenced a system of cultivation, into impenetrable forests, rendered even this labour supply precarious. In time the rapid multiplication of progeny and the licence of a community unfettered even by the restraint of tribal customs made the population of so-called Maroons not only useless for the purpose of agricultural enterprise, but a source of danger and terror. In these circumstances, it was impossible to realise from the development of the resources of the colony a revenue sufficient to yield a return on the capital of a trading company, and to provide for the exigencies of a naval station menaced by the struggle of European powers for the control of the sea-route to India. In 1710 the Dutch once more, and this time finally, abandoned Mauritius, transferring troops and colonists to the Cape of Good Hope. It has been constantly averred that the Dutch were driven out of Mauritius by the rats. It was not the rats but the labour question that proved too much for them.

Two Centuries of Occupation. — Thus closed the record of two centuries of European occupation with results that may briefly be summed up. In an island found uninhabited, there had been established a race of mixed, but mainly African origin, uncontrolled by any kind of political system, but united in violence of hostility to European civilisation. Economically, the resources of the island had been developed by the addition of useful trees and plants to its flora, and of live stock, especially cattle, to its fauna. On the other hand, the rats were left to increase and multiply exceedingly on the introduced flora.

The French in Isle of France.—In 1715 the white flag of Louis xv., King of France and Navarre, was hoisted in Mauritius, and the island annexed to his dominions under the name of Isle of France. In 1719 it was granted by charter to the French East India Company, and in 1723 it was provided with a political system. A Provincial Council, composed of six of the principal inhabitants, was created, and invested with legislative, judicial, and executive powers. The records of this period are meagre and conflicting, but what has been said of the period of Dutch

occupation and the causes which terminated it may suffice to indicate generally the difficulties which before long threatened the settlement. From a commercial point of view, the Company found the enterprise a heavy burden on their hands. The new colonists recruited from France and other areas of French activity had to be financed by the Company. They had no capital, and neither scientific knowledge nor experience of the requirements of tropical agriculture. To the difficulties that had discouraged the Dutch, there was thus added the experience of a financial crisis, an economic disturbance that has proved of frequent recurrence, and as formidable as the recurrent atmospheric disturbance known as a hurricane. It would certainly have wrecked the French occupation within twenty years but for the extraordinary genius of the man who was sent out to deal with it.

Mahé de La Bourdonnais.—It is difficult, within the compass of my address, to do justice to the administration of Mahé de La Bourdonnais. I must confine myself to a summary of his labours in developing the resources of the colony, and in securing it against internal disorder and external aggression. To make the colony self-supporting, he appreciated the necessity of a cheap and abundant food-supply, secure alike from destruction by hurricane, and from the risk of capture in transit inseparable from imported food-stuffs. Such a staple he found in manioc or cassava, which he introduced from Brazil. The expansion of agriculture he promoted by the introduction of products from every known region of the tropical world, and especially encouraged the cultivation of sugar. To facilitate transport, he taught the inhabitants to break in the wild cattle and substitute animal draught for carriage by slaves; he provided adequate roads to connect the harbours and districts of the island.

Turning his attention to the question of an adequate supply of labour—then, as now, the question of questions in climates where the manual labours of agriculture cannot be undertaken by European colonists—he engaged, at his own cost, in the introduction of natives from Africa under conditions repugnant to our modern sense, but at the time universally accepted by the civilised world. Against the internal danger of the Maroon population he was thus able to organise a force of kindred origin, illustrating the principle that the disorders of a turbulent community are best remedied by the educated and disciplined intelligence of its own race.

In undertaking the defence of the colony, La Bourdonnais, convinced of the superior advantages of the North-West Harbour, transferred to that quarter, to which he gave the name of Port Louis, the seat of civil and military government. With an enterprise and energy which admitted nothing to be impossible, he converted an encampment consisting mainly of straw huts, into a town equipped with public buildings and private residences, stores and shops, with barracks, fortifications, and arsenals. The exigencies of health were not overlooked. He constructed an aqueduct to supply fresh water, and a hospital for the service of the town and shipping. But it was to the harbour he devoted his chief efforts. His imperial mind had already appreciated the momentous bearing of sea power on the history of the

world, and he was perhaps the first to realise that, however formidable may be the strength of a nation in battle-ships, its commerce may be annihilated by the speedy cruisers and privateers of a rival power without a single battle-ship. He therefore determined to make Port Louis a station from which foreign trade could be crippled, as well as a strategic base for the operations of France in India. He equipped it for the reception of a fleet, and provided it with wet and dry docks. He not only undertook the work of shipbuilding with success, but in 1746 he made Port Louis the base of an operation seldom, if ever, paralleled in colonial history. "Without ships," says Colonel Malleson, "without sailors, without an army, the Indian Ocean covered by hostile cruisers,

Fig. 2.—Port Louis from the Sea.

with no resources but those he had made in the colony, he was asked to embark an army, to traverse the Indian Ocean, to avoid or encounter the trained fleet of the enemy, and to relieve the beleaguered capital of French India." The result of this expedition and the tragic fate of the heroic adventurer belong to another chapter of history.

His memory is held in equal honour by the representatives of England and of France in the colony, where in 1899 the bi-centenary of his birth was celebrated with appropriate ceremonies. Arrangements had been made for the fleets of England and France to take part in the celebration, but they were unfortunately prevented by a visitation of plague.

The Chartered Company and the French Nation.—La Bourdonnais finally left the Isle of France in 1746, and there followed a period of conflict between the commercial interests of a trading company and the

imperial interests of France in the only harbour of the Indian Ocean in which ships could ride with safety. It had been the aim of La Bourdonnais to reconcile these interests, but his schemes had involved a formidable expenditure, and the Company found itself in a position analogous to that of the Dutch East India when it abandoned the colony. The conflict was terminated in 1764 by the bankruptcy of the Company and the transfer of the administration to the Crown. It has been estimated that the transfer cost France 375 millions of livres, but whatever may have been the cost, we must accept the transfer as a declaration of the national faith that if the Isle of France were abandoned, the English would drive all other nations out of the Indian Ocean, and possess themselves of the wealth of Asia.

Isle of France a Crown Colony.—In 1766 the Isle of France received its first charter as a Crown Colony. The charter sought to reconcile the conflict of military and civil interests by the appointment of two administrators jointly responsible to the Crown. To the Governor was assigned the naval and military command, to the Intendant were assigned the judicial administration, finance, and the control of agriculture and commerce. The difficulties of this system of divided responsibility were not long in making themselves felt, but the selection of the first Intendant was almost as fortunate as had been the appointment of La Bourdonnais, and under M. Poivre the development of agriculture was pursued with energy and method. He reported at once to the Government of France that "coffee, cotton, indigo, sugar, pepper, cinnamon, tea, mulberries, cocoa and annatto had each had their turn, but that the knowledge and attention necessary to establish an experiment had always been wanting." To remedy this want of knowledge and method, he established in 1769 the Botanic Gardens attached to the Governor's country residence at Pamplemousses. They soon gained a world-wide fame, and have been, as they still are, a stay of the colony's fortunes and an ornament of which all Mauritians are justly proud.

Seat of Government-in-Chief.—In the meantime, the Crown Colony of the Isle of France rapidly grew in importance as a base of naval and commercial operations,[1] until in 1789 the seat of the government-in-chief of all the French establishments east of the Cape was transferred from Pondichery to Port Louis. But the time was now approaching when the Crown Colony, under the influence of the French Revolution, was to be raised to the status of a self-governing Colony in the fullest acceptation of the modern term.

Characteristics of Old France.—When the Prince of Wales returned from his Colonial tour, he declared with perfect felicity of phrase that Mauritius had preserved many charming characteristics of Old France. It was the period of the Revolution that fixed them, and at the same time dissociated them from other less charming characteristics of the old

[1] In 1785 the French East India Company was reconstructed as a trading concern under a Charter which gave the Isle of France concurrent privileges in a monopoly of trade between France, India and China, and exclusive privileges as an entrepôt for goods from Eastern ports carried by all French vessels.

régime. The following figures may serve as a guide to the population of the Isle of France during this period:

YEAR.	WHITES.	FREE COLOURED.	SLAVES.
1787	4372	2235	40,439
1797	6237	3703	59,020

Elements of Order.—The white population contained three powerful elements of order in the landed interest, in commerce, and in the Church. The land was mainly in the hands of retired servants of the Crown of military and maritime experience, drawn largely from the old *noblesse* but enjoying no feudal privileges. Commerce was dominated by a body of merchant venturers, who, to the profits of a great centre of trade in peace, added in war time the recognised and lucrative enterprise of privateering. The Church, unembarrassed by temporal privileges, exercised its spiritual influence in alliance with these forces.

Elements of Disorder.—At the same time there were three elements of disorder in the civil community, in the military, and in the Government of France. In the civil community elements of unrest were found in the generous enthusiasm of youth for liberty, equality, and fraternity; in a spirit of independence and intolerance of restraint inseparable from colonial enterprise; and in the meaner motives which in periods of national agitation prompt the idle, the dissipated, and the vicious, to turbulence. Among these elements of unrest the substitution of the tricolor for the white flag was followed by imitation of the revolutionary methods of France in the formation of Jacobin Clubs: La Chaumière, Rafraîchisseurs, Chevaliers d'Industrie, Sans-culottes—and even in the erection of a guillotine, fortunately satisfied by the vicarious sacrifice of a sheep. To these elements of disorder was added a spirit of mutiny among the garrison, which, not unnaturally, associated itself with the revolutionary spirit of the army in France; and the garrison was responsible for the only act of bloodshed committed, the murder of Count Macnamara, commandant of the French Marine in the Indian Ocean. But these elements of unrest proved less formidable than the action of the National Convention in France, which on the 4th of February 1794 decreed the immediate abolition of slavery without indemnity, and declared every man domiciled in the colonies without distinction of colour to be a citizen of France, with equal civil and political rights. Such were the influences that determined the evolution of the Isle of France into a self-governing colony.

Self-government.—By a decree of Louis XVI. of the 9th of April 1790, the colony was empowered to frame a Constitution for itself, and on the 21st of April 1791 a Constitution drafted, discussed, and adopted by the Colonial Assembly and ratified by the Government of France, came into force. By a resolution of the Assembly, it was subsequently decreed that no laws emanating from France should have force in the colony; and in 1798 the Assembly decreed a revision of its Constitution. By the Constitution of 1791 the supreme executive power was placed provisionally in the hands of the Governor. The exercise of this power

presented grave difficulties, but they were overcome by the genius of the Governor, Count Malartic, who with admirable foresight placed himself in the position which the experience of subsequent generations has assigned to the Governor of a self-governing British colony.

The Colonial Assembly and Slavery.—As it was the policy of the colony in respect of slavery that determined the issue of the conflict between the forces of order and disorder, it is important to understand it. It was clearly defined in its aims and methods. Its end was the abolition of slavery, and its methods were the immediate abolition of the slave trade;[1] the amendment of the *Code Noir*, the organic slave law of France, by the abolition of all punishments of exceptional severity;[2] and the admission of free people of colour to equal rights with the white population.[3] But to the immediate abolition of slavery as decreed by the National Convention the colony resolutely refused its assent.

Isle of France and Hayti.—The American philosopher Emerson declared that history reveals nothing more remarkable than the ease with which a benefactor may become a malefactor only by the continuation of his activity into an area where it is not due. And the truth of the aphorism has never been asserted with more tremendous energy than in the history of the abolition of slavery. It has afforded a lesson to all time in the contrast between the influence of the principles of the French Revolution in Hayti and in the Isle of France. In Hayti the racial antipathies of colour, generated by slavery, broke out into the most vindictive conflict on record—a conflict which exterminated the European community, destroyed capital in every shape, paralysed labour, and arrested the evolution of the forces which in the Isle of France, struggling now slowly, now rapidly, but on the whole continuously, have worked out the conditions necessary to political sobriety, equality of civil rights, and economic prosperity.

FIG. 3.—The plateau of Plaines Wilhelms, showing the Military Camp at Vacoas.

The interval of two years between the passing of the decree of the 4th of February 1794 and the attempt to enforce it, gave the cohesion of an united purpose to the forces of order in the colony and

[1] Laws of the Colonial Assembly, 26th February, 5th March, 20th September, 1794.

[2] Laws of 4th December 1790, 6th February 1794.

[3] Laws of 22nd August 1792, 18th January 1793, 18th March 1794.

allied with them the sacred cause of wives, mothers and daughters, to whom the fate of their sisters in Hayti had revealed terrors worse than death.

The Crown of Self-government.—On the 18th of June 1796 a naval detachment brought to the colony the Commissaries of the French Republic, sent to proclaim the immediate emancipation of the slaves, and to terminate the political independence of the Isle of France as a self-governing colony. But the popular will had determined that the colony had no use for the agents of the Directory, and on the 22nd of June, after four days of a determined but bloodless conflict, they were forced to re-embark. In 1798 the colony rid itself of the turbulent element in the garrison, and before long the last elements of disorder were expelled.

Notwithstanding the desperate struggle for existence in which the self-governing colony was engaged, it found time to develop its internal resources, while its maritime activity was such that the prizes taken into Port Louis were numbered by thousands, and their value estimated at millions of pounds sterling.

The defence of the island and the proceedings adopted in the teeth of the revolutionary events that threatened its destruction at this time "belong," says the historian Pridham, "rather to the age of romance, were not romance set aside by reality. Seldom, perhaps, has history furnished an example on a parallel with this instance, an instance in which a single and inconsiderable island, denuded of nearly the whole of its military force, by the natural strength of its position and the bravery and patriotism of its inhabitants, singly and for a long time resisted the hostilities of the mightiest of nations. . . ."

End of Self-government.—In May 1802 the political independence of the Isle of France was terminated by its submission to a decree of Bonaparte as First Consul of the Republic suspending the Constitution, re-establishing the slave trade, and restoring the legal status of slavery under the Code Noir. A provisional government was now set up with absolute power vested in a Captain-General, a Colonial Prefect, and a Commissary of Justice.

General Decaen.—It is only just to recognise the eminent services in the civil administration of the colony of the illustrious officer, General Decaen, appointed Captain-General. The Code Decaen may be said to have been to the Isle of France what the Code Napoléon was to France, and in the *Lycée Colonial* he laid the foundation of an institution which, as the Royal College, has done more to remove prejudice arising from the accident of origin and convictions of consciences than all other influences put together.

A Unit of Empire.—But the Isle of France had now become a unit in a vast military system organised to establish, under the dictatorship of Napoleon, a universal Empire of which Europe was to be the head, America and Asia the arms, Africa the shoulders and trunk, the Atlantic and Indian Oceans the legs and feet. And it was the importance of the unit in this imperial enterprise that determined its destiny.

The Sea-route to Asia.—We have seen in the transfer of the Isle of

France to the Crown an expression of the national belief that if the colony were abandoned, England would make herself mistress of the wealth of Asia. In England, statesmen, generals, and admirals, in India, governors and councils, had been unanimous in declaring that possession of the Isle of France was essential to our commerce, to our reputation and national character, and to the maintenance of our province, India. It fell to Lord Minto, Governor-General of India, great-grandfather of the present Viceroy, to determine the question of possession by the *ultima ratio* of a force the most powerful in strength and equipment that had ever been afloat in the Indian Ocean.

Naval Achievements.—The operations of war which transferred the Isle of France to British rule are outside the scope of my address. The Prince of Wales on his visit referred in generous terms to the just pride of the colony in its great traditions and "in its association with naval achievements that shed equal glory on England and France." Among the most famous of these achievements was the action of the Ile de la Passe on the 23rd of August 1810. The French under Commodore Duperré were victorious, but a naval historian has declared that the noble behaviour of Captain Willoughby and the officers and crew of the *Néréide* "threw such a halo of glory round the defeat that the loss of four frigates was considered scarcely a misfortune." An obelisk has been erected in honour of all who fell on that memorable day; and the Ile de la Passe occupies in the annals of Mauritius much the same place as the Plains of Abraham in the annals of Canada.

Capitulation and Treaty.—On the 10th of December the Isle of France surrendered to the overwhelming force sent against it, the terms of capitulation securing to the inhabitants their religion, laws and customs, and property. By the Peace of Paris, 1814, the Isle of France was ceded to Great Britain in full sovereignty, and under the restored name of Mauritius remains the star and key of the Indian Ocean.

FIG. 4.—La Fenêtre.

The Record of French Occupation.—Lest it be thought that I am exalting above measure the place of Mauritius in history, I will close this brief record of French occupation in Colonel Malleson's eloquent words:—

"Thus did the French lose, after an occupation of nearly a hundred years, the beautiful island upon which had been bestowed the name of their own bright land, and which in climate, in refinement of luxury, in the love of adventure of its children, had been, in very deed, the France

of the East. In the long struggle with England which had followed the Revolution, the Isle of France had inflicted upon the English trade a 'damage which might be computated by millions,' whilst she herself had remained uninjured,—for eighteen years indeed—unthreatened. She had proved herself to be that which the Emperor had declared that Cherbourg should become,—'an eye to see and an arm to strike.' Protected for long, partly by the storms of the ocean, partly by the daring spirit of her children, partly by the timid counsels of the British Government, she had been, for the privateers who preyed upon the commercial marine of the East India Company, at once a harbour of refuge and a secure base of operation. She had been the terror of British merchants, the spectre which haunted the counting-house, the one black spot in the clear blue of the Indian Ocean. The relief which was felt by the merchants of Calcutta was expressed in an address presented by them to Lord Minto, in which they offered their 'sincere congratulations on the capture of the only remaining French colony in the East, which has for so many years past been the source of devastation to the commerce of India, to a magnitude almost exceeding belief.'"

The British in Mauritius.—Although Mauritius, under British rule, has ceased to be associated with the romance of great naval achievements, the policy of government has of necessity continued to exercise itself in two areas of activity: the administration of a base of maritime operations, and the development of the resources of a tropical territory. In the term "maritime operations" I include the functions of the Royal Navy and the Merchant Service. The importance of Mauritius as a unit in any system of imperial defence constituted on the principle that the maintenance of peace depends on an adequate preparation for war, has never failed to be recognised. And the colony, dependent for its existence on its sea-borne commerce, has even in the darkest days of its fortunes cheerfully borne its share of the burden of defence at home and protection in transit, as a premium of insurance. This practical wisdom, associated with the sentiment of old traditions, has always secured for the British Navy as cordial and enthusiastic a welcome as it receives in any seaport or city of Scotland. Nor has the period of British dominion been without services rendered to the Empire in war-time of which the colony is proud: by the prompt despatch of troops to India in 1857 during the Mutiny; to South Africa in 1879 during the Zulu War; and to South Africa again in 1900 at a critical stage of the last war. In 1857 grave anxiety was entertained as to the internal security of the colony while denuded of a portion of its large garrison. It was the period of an *entente cordiale* following the Crimean War, and it is of interest to recall that the French Governor of Réunion wrote to the Governor of Mauritius offering him in case of need the support of the French troops in his command. In 1879 a detachment was sent with very little fear of internal difficulties. In 1899 the services of every white soldier in the garrison were placed at the disposal of the War Office without any apprehension at all. And it may be added that on this occasion the troops arrived at Durban within

six days of the hour of their receiving notice to hold themselves in readiness.

Great Trade-route to Asia.—We have seen that the protection of the British merchant service on the trade-route from Europe to Asia was a main determining cause of the transfer of Mauritius to British dominion. With the growth of eastern commerce and the introduction of steamers, Mauritius rapidly became a victualling, docking, and coaling station of unrivalled value in the Indian Ocean.

The Observatory.—At the same time, the constantly recurrent cyclones on the track of navigation between the Cape and Asia enforced the importance of the colony as a station for the study of the law of storms. In 1851 a Meteorological Society was formed, and in 1870 the foundation-stone of the Royal Alfred Observatory was laid by the Duke of Edinburgh. Since 1893 the telegraph has made it one of the most important units of the imperial system of meteorological, magnetic, and seismometric observations. For nearly half a century our countryman, Dr. Charles Meldrum, was the inspiring genius of the work. On his storm atlas, his synoptic charts, his theory of the law of storms, and his rules for avoiding the track of cyclones are based the sailing instructions issued to mariners for the navigation of the Indian Ocean. The observations he conducted have now determined all the factors of the climate, and are available for international use. From May to September the weather conditions at Mauritius are cabled every week to India for use in connection with the monsoon forecasts. Similar cablegrams go to Egypt in connection with the Nile flood forecasts. It only remains for an international system of wireless telegraphy to be established to complete the value of the Mauritius observatory for the uses of navigation. In its latest service to commerce, the observatory has entered on an unexpected area of activity in furnishing the means by which insurance on sugar crops and mills can be effected on a satisfactory basis. The observatory records have determined the relative effects of cyclones, rainfall, and temperature on the sugar crop, and have given a numerical value to each. It appears that popular opinion has considerably over-rated the first and under-rated the last factor. The figures now established furnish the only proper basis of calculation on which insurance companies can determine their premiums within very narrow limits.

The Suez Canal and dependence on internal resources.—The opening of the Suez Canal in 1869, which beggared the colony of St. Helena, dealt a serious blow to the local interests connected with shipping in Mauritius, but it has placed in striking relief the wisdom of the policy which has made it a chief aim of the administration to find an adequate and permanent source of prosperity in the development of the resources of the colony. In this area of activity the Botanic Gardens at Pamplemousses continued to be the centre of enterprise, and such was the success of the sugar industry that the export of sugar rose from 467 tons in 1812 to 131,000 tons in 1860. It was calculated that the small island was at that time producing about a tenth of the exported sugar of the whole world. I must not discuss the struggle for existence of the cane-sugar

industry against its rival, the beetroot, but I may say, that to meet this formidable competition in Mauritius all the secrets that science has wrested from Nature have been applied to practical uses alike in the field and in the factory.[1] Nor has the encouragement of subsidiary industries been neglected. As cultivation has gradually been extended from the seaboard to the highest cultivated areas, agronomic and botanic stations have been established at altitudes of 1000 feet and 1800 feet for scientific experiment in products appropriate to the conditions of the higher ranges, such as tea. And in this enterprise the colony has been materially assisted by the Royal Botanic Gardens, Kew. At Kew has been carried on the work of collecting, identifying, and classifying the species of economic plants best adapted to the climatic and other conditions of all parts of the Empire, and the results of the vast mass of information thus acquired has been placed at the disposal of the colony. In this way the crowd of introduced products from all quarters of the globe has been such that they have replaced the original flora of Mauritius to an extent probably greater than in any part of the Empire.

Transport.—Meanwhile the work of providing facilities of transport, started by La Bourdonnais in the substitution of animal draught for slave carriage, has been steadily developed. Cattle were imported from Madagascar and India, horses from the Cape and Australia, ponies from Pegu and Timor, mules from France and South America. Railroads were introduced, and have of late been widely extended, while from reasons which will be presently explained the island has been covered with a network of surface and overhead tramways.

Malaria.—In 1866 the government was forced to extend its activity in a new area by an epidemic of malarial fever, which caused an enormous mortality, and a vast depreciation of property in Port Louis and the seaboard area first invaded. The epidemic subsequently resulted in the displacement of the homes of a large section of the community and a redistribution of the population in the more elevated districts. From that time the department of health and sanitation has been one of the first concerns of government, and in this department the colony has been able to avail itself of the world-wide experience collected in the British schools of tropical medicine and in France. Major Ronald Ross is at this moment in the colony on a mission of inquiry into the best means of combating malaria.

Abolition of Slavery and the Labour Question.—But after all, the application of science to practical uses in the processes of production, of transport and of sanitation, is in the development of territorial resources subsidiary to the essential condition of an appropriate population. In tropical and sub-tropical countries the first essential condition of an appropriate population is a sufficient labour supply for the elementary operations of industry which cannot be undertaken by the white man.

[1] My experience leads me to believe that the consumer of cane-sugar in this country has a very inadequate conception of the capital required to provide and keep up to date the equipment of a modern factory. I regret that the exigencies of time and space preclude me from giving a description of such a factory.

In Mauritius, as elsewhere prior to the abolition of slavery, these operations were performed by African negroes. It is certain that if the emancipated slaves could have been persuaded to carry on the elementary operations of agriculture, they would have learned in time that the cultivation of land leads to its acquisition, and they would have kept in their hands the natural wealth of the soil, which has in a large measure passed to a race which has supplanted them. The policy by which the British Government, and in particular Lord Grey, endeavoured to secure the adhesion of the emancipated slaves to the soil failed, but in other respects the British Government has successfully discharged the trust and function assigned to it as guardian of the African descendants in the colony. Lord Grey's policy was based on a theory, still advocated, that the pressure of a small tax would compel the negro to work in order to obtain the means of meeting it, and that the process would encourage a general disposition towards frugal industry.

Asiatic Labour.—Ever since the abolition of slavery, the substitution of Asiatic for African labour, with its consequences, has dominated the political history of Mauritius. Between 1834 and 1839 there were introduced about 24,000 Indian coolies under a free system of engagement for five years. In 1839, when this system was first legalised by ordinance, it was immediately suspended in consequence of an agitation in Parliament; but in 1842, after an inquiry undertaken by the Government of India, immigration under contract was resumed. In 1874 the system was again the subject of inquiry by a Royal Commission, and their report was the basis of the organic labour law of the colony. In 1894 a friendly inquiry into the working of the law was conducted by a commissioner appointed by the Government of India, with the result that some important modifications in the law and in the administration of the system have been effected. The law of Indian immigration under contract as it now stands may be said to embody legislation based on long experience, sanctioned by both political parties in Parliament and by the Government of India, and approved by both of his Majesty's present Ministers who have held the offices of Governor-General of India and Colonial Minister, the Marquess of Ripon and the Earl of Elgin.

Indian Immigration under Contract.—In appreciating the policy of protected Asiatic immigration, it must constantly be borne in mind that in view of the refusal of the African population to carry on the elementary labours of agriculture on the estates, there was practically no alternative but the abandonment of the island, which would certainly have reverted to France. It is possible that, at a time when the British Government was seriously contemplating the secession by consent of her colonies, such an alternative might have been admitted, but it is certain that, in the revival of colonial enterprise and the struggle for the control of the Tropics, we should, notwithstanding the modern trade-route of the Suez Canal, have found our imperial interests hardly less seriously compromised by such action at the close of the nineteenth century than they were at the close of the eighteenth. Coincidently the same policy, controlled by the same methods, saved our West Indian

Islands, which but for the migration from India must have gone out of cultivation. They would, beyond all doubt, have passed into the hands of the United States, and carried with them undisputed supremacy in the Caribbean Sea.

The Indians in Agriculture and Commerce.—While the direct object of immigration from India was the supply of unskilled manual labour, it has had far-reaching consequences. The frugal industry of the Indian labourers, when they have ceased to enter into engagements by written contract under the labour law, has gradually enabled them to acquire a vast number of small holdings, to the great advantage of the colony. They have thus given a value to and kept in cultivation an extensive area of land which must otherwise have been abandoned; their canes have been a profitable source of supply to the sugar-mills of the large estates; and the cultivation of their small holdings has left them ample time to work as gardeners, carters, carriers, hawkers, and pedlars. In this way they have acquired almost a monopoly of the carrying business, and this has served as a link connecting them with agriculture on one side and trade on another. For in the meantime a consequence of the Asiatic immigration was the introduction of rice as the staple diet of the whole colony, while coincidently the competition of beet-root sugar in Europe and other causes made India the chief market for Mauritius sugar. Thus the bulk of the export and import trade, including nearly all the commodities that enter into the constant consumption and use of the population, has been transferred from Europe to Asia, and has fallen into the hands of the Indian traders, mostly representatives of wealthy Bombay firms. They have naturally helped to find employment for their countrymen in the carrying and hawking trade as distributors of their commerce.

Population 1901.—This explanation seems necessary to an understanding of racial development in Mauritius, as indicated by a comparison of the population in 1830 before the abolition of slavery with the results of the last census:—

POPULATION OF MAURITIUS EXCLUSIVE OF MILITARY AND SHIPPING.

1830 *Approximate.*

Whites,	8,592
African Descendants:	
Slaves,	69,476
Free Coloured,	18,019
Indians and Chinese,	858
Total,	96,945

Census 1901.

	MALE.	FEMALE.	TOTAL.
Europeans, white, mixed, and coloured,	53,038	55,377	108,415
Africans,	332	100	432
Indians,	144,957	116,023	260,980
Chinese,	3,451	58	3,509
Total,	201,778	171,558	373,336

A comparison of these returns shows a most remarkable racial development.

The General Community.—The population of 108,415 includes all persons with European blood in their veins, and with the 432 persons returned as Africans is known locally as the general community. The members of this community of pure European descent cannot exceed 5000. The English element is very small, and may be said to stand in much the same social relation to the French element as the corresponding elements of Canadian society. The predominant influence is that of the families who brought in and have maintained "the charming characteristics of old France." They enjoy the respect still entertained in England and even in republican France for a small circle of society where the traditions of birth are associated with personal virtues finding expression in the sentiment *noblesse oblige*. They cling to each other "in either fortune" with a brave tenacity of attachment. Their ladies represent the *grandes dames* of European society. But their influence is purely personal, as is the influence, of a different order, of the English representatives of English capital and enterprise. Otherwise there is no distinction of origin. There are, of course, social gradations as there are in Europe, and in the colonies that claim to be exclusively reserved for the use of the white man. But the State recognises no aristocracy but that of office; society none but that of merit and success. High office in the administration, the dignity of the Bench, the honours and emoluments of the learned professions, the influence of landed property, the profits of commerce are open to all. The general community supplies the staff of the government offices, including the Public Works, Railway and Harbour Departments, as well as the staff of all private enterprises except those undertaken by the Indian community. They also do practically all the skilled artisan and mechanical work of the colony. The small number of persons returned as Africans, which the Registrar thinks may be somewhat under-rated, includes an intrepid and skilful body of men engaged in the fishing and coasting trade. In the evolution of the general community the principal forces at work have been education and the Christian religion. Education has been a chief concern of the State, but its success has depended on the support and aid of the Churches; and if it is impossible for me to give an account of their methods of influence, I may at least do homage to their loyal co-operation with the civil government.

Indian Community.—On the subject of the Indian community I need only add to what has been said that, between the traders who have acquired estates and the proprietors of small holdings, it owns more than one-third of the whole cultivated area of the colony, nearly all of which would have been abandoned but for the enterprise and industry of these men. The Indian community includes over 200,000 Hindus, about 40,000 Mahomedans, and 3000 Buddhists. It also includes many Christians, who form a close bond of union with the general community.

The Chinese.—The Chinese are a peculiar people, and occupy a peculiar position in Mauritius, as elsewhere. They have served a useful purpose and have always loyally submitted themselves to the regulations

and wishes of the government. But they have acquired a monopoly of the retail provision trade by methods which I have always regretted. They have made this branch of trade subsidiary to the retail liquor trade, of which they have also acquired a monopoly, and the profits of the liquor trade enable them to undercut competition in the provision trade. If the profits of the retail liquor trade were transferred from the Chinese to the government for public purposes, it is probable that the Chinese immigration would cease, and the legitimate profits of the retail provision trade would be restored to the general community. I made a proposal in this sense before I left Mauritius, but I fear it has not met with encouragement. The Chinese perfectly understand that Mauritius affords a very limited area for their transactions, and that if they increased and multiplied, competition among themselves would reduce the small margin of profit with which they are satisfied, below a living wage. With rare exceptions, therefore, they never bring their womankind with them, and have no intention whatever of becoming permanent residents. They work "for all they are worth," to enable them to return home as soon as possible with what is to them a sufficient fortune. By arrangement among themselves—an arrangement with which the government has nothing to do—about 10 per cent. repatriate themselves every year, and make room for others. This will explain the small percentage of females in the census return.

The Constitution.—The political constitution of Mauritius has been frequently modified under British rule, but it was only in 1884 that the principle of election to the legislative body by popular suffrage was admitted. The head of the administration in the present system is the Governor, who is assisted by an Executive Council and a Council of Government. The Executive Council consists of five official heads of departments and two unofficial members appointed from among the members of the Council of Government by the Secretary of State. The Council of Government includes the Governor and eight official heads of departments, nine nominated members, and ten elected by popular suffrage on a moderate property qualification. The elected and nominated members together represent the popular will. The elected members represent, of course, majorities, and generally speaking a democratic spirit. The nominated members have a more conservative tendency, and exercise an important function in the representation of minorities and groups of interests not directly represented in the elected body, such as external capital and commerce. They include and will always include, I hope, a member of the Indian community, until that community secures direct representation by election. The Indian community are not keen politicians, and have been satisfied to leave themselves in the hands of the government rather than seek election to the Council of Government, from which there is nothing in the constitution to exclude them. The function of the Governor and heads of departments in the Council is to balance the elements of the popular will and to represent Imperial interests in matters of defence and foreign relations; to maintain the civil and political rights of all his Majesty's subjects in the colony; and to control the finances for which the Imperial Treasury

is in the last resort responsible. It will be seen that it is a form of constitutional government which includes the democratic spirit and its check in a single chamber. Long experience in nearly every colony which has been admitted to self-government since the secession of the American colonies has proved that it is a form of government that can only exist by virtue of a spirit of mutual forbearance and goodwill; because, when the two elements of the popular will form a *bloc*, the government responsible for the administration must always be in a minority. Nevertheless, the experience of Mauritius has proved that with such a spirit it may serve as a *modus vivendi* appropriate to a community of European, African, and Asiatic descent that has learnt to realise the letter and spirit of Queen Victoria's proclamation to the people of India in 1858, declaring that "no native, nor any resident natural-born subject of Her Majesty, should by reason only of his religion, place of birth, descent, colour, or any of them, be disabled from holding any place, office, or employment under the Government."

Local Government.—It should be added that in Mauritius the administrative system includes a scheme of Local Government. In Port Louis, the capital, a Municipal Corporation is elected by suffrage; in the districts there are Town Boards, members of which are nominated by the governor, whose duty it is to secure a fair representation of interests. These agencies exercise a material influence on the *modus vivendi*. It remains for me to illustrate the resistant and recuperative efficiency of the *modus vivendi* by a record of what was actually accomplished in Mauritius during a period of misfortune hardly paralleled in the history of our colonial Empire.

Hurricane and Fire.—Early in 1892 Mauritius was visited by a hurricane which in a few hours killed 1260 people, wounded 4000, rendered 50,000 homeless, knocked down twenty-four churches and chapels, and many public buildings. On the sugar estates it destroyed many mills, with their costly machinery, and reduced a promising crop by one-half. In order to appreciate the effects of this hurricane, it must be borne in mind that there are in Mauritius few accumulated fortunes; capital is almost exclusively domiciled in Europe, and, as regards the Indian traders, in India. The bulk of the community lives on the annual proceeds of the sugar crop. From this source are derived public and private salaries, professional emoluments, and the wages of the working community.

In 1893 a great fire lapped up what the hurricane had left in the principal business area of Port Louis.

Against these appalling disasters the general community struggled with a courage worthy of the great traditions of Mauritian history. In the Indian community the merchants exercised a generosity which earned the grateful acknowledgment of the colony and the thanks of the Imperial and Indian Governments. At the other end of the social scale, the indentured labourers on the estates volunteered to accept a reduction of their statutory wages.

Financial Crisis.—Misfortunes never come single-handed. There followed a short crop, an enhanced cost of supplies from India due to

famine and plague, and allied complications leading to a financial crisis. It had to be met by government assistance to the banks, a loan to planters (punctually repaid with a margin of profit), and the suspension of specie payments—measures of grave anxiety only justified by the peril they successfully averted.

Plague and Surra.—It was hardly averted when an epidemic of plague broke out. Apart from the fatality of the disease, which, so far at least as the Asiatic community is concerned, is perhaps the smallest of its terrors, it is attended by subsidiary difficulties and dangers arising largely out of the measures adopted to arrest its progress. These are now getting to be understood in this country by the records of experience in India. They affect smaller communities with even more acute severity, and they strained the courage and the resources of the colony in a way that can hardly be realised by those who have had no similar experience.

In 1901 the Prince and Princess of Wales visited Mauritius, and replied to the addresses of welcome presented to them in these gracious terms:—

"We deeply sympathise with you in that combination of adversities altogether beyond your control, under which you have suffered during the past ten years.

"Meanwhile the whole Empire has watched with sympathetic admiration the constancy and courage by which you overcame your difficulties and the spirit that prompted you to contribute generously—in spite of your own imperilled fortunes—to the relief of your suffering fellow-subjects in India, the West Indies, and in South Africa."

In 1902 the epidemic of plague was followed by an epizooty of the disease known as *surra*, which attacked horses, mules, and cattle with cruel severity, and from an economic point of view was more disastrous than the plague. Such was the fatality of the disease, that within a year it dislocated the whole system of transport by animal draught throughout the colony, and it became necessary to substitute, at enormous cost, a mechanical system of transport by means of light railways, surface and overhead tramways, and automobiles. The consequences of the loss of animals affected not only the sugar industry, but every department of public and private activity, including the work of sanitation in both urban and rural districts.

An independent witness wrote of the courage with which this calamity was met in terms which I may well recite:—"When one knows the extraordinary courage with which planters, overseers, and labourers alike here have faced the plague, cattle disease, and torrential rains to which they have been exposed during the course of the last two years, and that planters have not shrunk from any sacrifice to maintain, and generally to maintain with intelligence, their estates; and when one knows and has seen the Indian labourers, owing to the dearth of draught animals, harnessing themselves to heavy carts and dragging them along the estate roads in the middle of the rains, willingly and cheerfully bearing all hardships to finish the crop, I cannot think that classes which show such spirit to maintain an industry, which is capable

of doing well in fair competition with the world, should be allowed to sink; and that no hand will be held out to them in their time of trial."

During this period of adversity the popular conscience was guided and controlled by the influence of the unofficial members of Council, aided by the leaders of the Indian community within their sphere of influence. And fortunately the colony had in its civil service a body of men steeped in the sympathy of common interests with the sentiments of the people. In the strain put on the departments every demand was met with patience and industry, many pressing emergencies with conspicuous ability and fertility of resource.

The Financial Strain.—It will easily be understood how gravely this series of untoward events affected the colony's finances. An account of the financial administration would be outside the scope of this address. But it is right to declare that the representatives of the community from first to last recognised that above all things it was necessary to maintain the colony's credit, and in its most straitened circumstances Mauritius never followed the example of other colonies by borrowing money to cover annual deficits in the public expenditure. The financial policy of the colony has been for many years controlled by the recurrence of hurricanes and their disastrous consequences. It has, therefore, steadily adhered to the sound system of meeting the ordinary expenditure of the year out of the revenue of the year, with a sufficient margin of surplus to form a fund available for a period of emergency or for public purposes, such as railway or harbour improvements. But, of course, exceptional measures had to be taken to meet the strain of a series of exceptional emergencies. The period of the financial year was changed to adapt it to the seasons of the sugar crop. The whole system of keeping, auditing, and rendering the colony accounts was recast, and a new procedure was adopted in submitting the estimates to the Council of Government, so that the unofficial members, a body including representatives of the principal mercantile firms well versed in accounts, might have more ample facilities for examining them.

Reorganisation.—Coincidentally, the principal departments of government, including the customs and the post-office, were the subject of inquiry by commission. On these committees the elected members of Council and other gentlemen outside of the official sphere gave their time and experience, so that the departments might at the same time be adapted to public exigencies and placed on a business footing. But above all, in view of the principal causes of the colony's misfortunes, the department of health and sanitation was made the subject of an exhaustive inquiry, having for its aim to adapt the department to the requirements of the new science of tropical medicine, and the demands made on it by the exigencies of malaria, plague, and *surra*.

An Appropriate Population.—I must count myself unfortunate if I have failed to show that the evolution of the Crown Colony of Mauritius has resulted in an appropriate population of European, African, and Asiatic descent, enjoying equal civil and political rights without distinction of origin or creed, appropriate to the development of the

resources of the soil, to the exigencies of commerce, to the high trust and function of administrative and legislative authority.

The Crown.—It was remarkable on how many occasions the influence of the Crown was manifested during the period of the colony's adversity. The Diamond Jubilee of Queen Victoria, her Majesty's demise, the accession and coronation of King Edward VII., revealed a sentiment of attachment to the Crown superior to all considerations of race or language.

Most opportune was the visit of their Royal Highnesses the Prince and Princess of Wales in uniting every section of the population in the sentiment of a common patriotism, and in confirming the constancy and courage of which their Royal Highnesses showed a generous appreciation. At the back of every man's mind in the Crown Colonies there is a sentiment of devotion to the Crown rooted in the faith that behind the things that are seen, heads of departments, judges and governors, there is an unseen power, the source of security of life, liberty of person, freedom of conscience, and absolute equality before the law for rich and poor of every race and creed. In Mauritius, as elsewhere, it was long known only by the name of Queen Victoria. The visit of their Royal Highnesses was accepted as a message of assurance that it had passed to King Edward VII., and the gracious sympathy with which the message was delivered will for ever associate it with the annual celebration of Empire Day, and all that Empire Day means, in the Crown Colony of Mauritius.

A VISIT TO BURMA.

By A. L. Cross, F.R.C.I.

(With Illustrations.)

Burma is now a very accessible country compared to what it was some years ago. The Bibby Line of steamers, starting from Liverpool and calling at Marseilles, make no stoppages except at Port Said and Colombo, and land their passengers at Rangoon within twenty-three days from Marseilles. There are of course other routes, such as by the P. and O. to Bombay, but this is the easiest and most comfortable, as there is no change of steamer.

After leaving Colombo, the capital of Ceylon, the route is along the western seaboard, and lovely views, especially in the winter season, when seas are calm, are obtained from the deck of the steamer. Such places as Point de Galle, Matura and Hambantota are distinctly visible with the aid of a good telescope. The southern highlands of Ceylon are also in view all day long. The lovely green of Ceylon is only surpassed by that of the Andaman Islands, which become visible on the third day out from Colombo. There are some six islands visible from the west, the principal being South Andaman, in which is Port Blair, the Indian Government convict settlement, Middle Andaman, and North

Andaman. On North Andaman "Saddle Mountain," 2000 feet high, is a prominent object on the east side of the island. Besides these named, there are a host of smaller islands, principally on the east side. The climate is very hot and damp, and very relaxing to most Europeans.

The approach to Rangoon is by the Rangoon river, which is practically a branch of the Irâwadi. The land on both sides is flat, and little above sea-level. It is only by sighting first the lightship on the Krishna shoal, and later on the lighthouse at Elephant Point, that one

Fig. 1.—Shwe Dagon Pagoda.

knows that land is not far off. The mouths of the Irâwadi are not visible. By and by, as one approaches nearer to the great city, the Syriam Pagoda comes in sight. Syriam was once the trading port of Burma, where the Portuguese and Dutch had factories in olden times, but is now principally noted on account of the extensive oil refineries of the Burmah Oil Company. Then when the harbour is reached the Shwe Dagon Pagoda, with its huge dome overlaid with gold leaf, and glittering in the sun, comes into view (see Fig. 1). For massive grandeur this pagoda has few equals in the world. Whether the Burmese themselves take a special pride in it, it is difficult to say, for the Burmese are rather a reticent people. Although there is one special large pagoda it has,

from time to time, been surrounded by smaller shrines, in many cases richly and exquisitely carved. These have been built by Buddhists who wished to acquire merit. The curious thing in this religion is that wealthy people who wish to acquire merit build pagodas for themselves, but no one ever thinks of repairing a ruined pagoda, of which there are thousands throughout the country, for they would not consider they were acquiring any merit by repairing another man's shrine. The Shwe Dagon is kept in the best state of repair of any pagoda to be seen in Burma. There are many worshippers to be seen at all times at the various shrines—filled with endless wooden Buddhas—presenting offerings of flowers, etc. I fear it is the merest idolatry on the part of the laity, and not philosophic meditation. The covered passage leading from the road up to the main pile of the pagoda is utilised as a sort of bazaar for the sale of flowers for offerings and various articles. The small Sale Pagoda in the centre of the city is also in good preservation.

Rangoon is rapidly becoming a great commercial city. Its river is full of the ships of all nations. The ubiquitous Tamil from Southern India and the Bengali are rapidly ousting the Burmese from all labour and domestic work, and the Chinamen and their Burmese wives are monopolising the bazaar and carpenter work. The Burmese, like the Singhalese, are agriculturists, and prefer to work for their own hand and not so much for other people, and the country life is more free and easy.

The Gardens and Lake at Rangoon are beautiful, and afford ample scope for exercise in walking and boating. There is also a small Zoo.

The aspects of a country strike travellers in different ways. One of the principal features here, at least in Lower Burma, is the enormous extent of rice cultivation. From Rangoon to Mandalay, a distance of 350 miles, the country might be said to be one vast paddy (rice) field. This is not surprising if any one looks at the map of Burma and sees what a well-watered country it is. None of the rivers ever dry up, and in fact as the weather gets hotter in March, the Irâwadi, Chindwin, etc., fed from the snows of Eastern Tibet, increase in volume, though no rain to speak of may fall in the region betwixt Rangoon and Bhamo, a distance of over 1000 miles. So far as I have heard, the upper sources of the Chindwin and the Irâwadi still remain to be explored.

For the first 150 miles from Rangoon, on the way to Mandalay, the railway runs through a flat country, with scarcely a tree to be seen, except in the nullahs—nothing but endless paddy fields. The crop this year (1907) was so great that it took months to remove it, both by rail and steamboat. At the railway stations, as we passed in January, the paddy was lying piled up in bags 6 to 8 feet high awaiting transport to the rice mills of Rangoon, and we observed the same thing at the steamboat landings on the banks of the Irâwadi. Burma might well be called the granary of India.

The journey from Rangoon to Mandalay by rail occupies about eighteen hours, and the line being on a 3 feet 5 inch gauge, progress is slow. Beds are made up in the first-class carriages, but the jolting is too

great for sound slumber. It is a great pity, for the sake of speed, that a broader gauge has not been adopted.

The greatest object of interest at Mandalay is King Thebaw's Palace. Thebaw, and Thebaw's Queen, who was really his half-sister, have been made famous by Fielding Hall in his charming books, *Thebaw's Queen* and *The Soul of a People*. Probably Thebaw was not as black as he was painted. For twenty years he was a monk, and had little knowledge of the world. The palace stands in a walled enclosure four miles square, surrounded by a moat with guard gates at intervals. Whatever the grounds may have been in Thebaw's time, they are nothing remarkable now. The ground is rather sandy, with a scanty covering of grass, and trees here and there. The palaces of the king and queen are both of wood (teak), which lasts a long time in such a dry climate. At one time a portion of the queen's palace was used as a club for Europeans, but Lord Curzon ordered it to be given up in case of fire. It is simply empty, and there is no furniture in any of the palaces—just the wooden walls and posts. There is a watch-tower all of solid wood, said to have been built by Mindon Min, Thebaw's father, and to have been erected in a day, under penalty of beheading. On the roofs of some of the buildings are curious erections looking like dog-kennels. The story goes that a huge eagle, like Sinbad the Sailor's Roc, had picked up a prince one day, and was sailing off gaily with his prey when an archer shot it, and ever after archers were stationed in these erections to shoot the eagles. There seem to be no eagles now, only a species of kite very common about the city. We visited the celebrated Aracan Pagoda and the monastery built for the monks. The figure of the Buddha in this pagoda is said to be the oldest in Burma, and must have been brought there, as Mandalay is the newest capital in Burma, having been built by Mindon Min, Thebaw's father, who seems to have been a very able man. I had a very interesting conversation with Captain Redman, captain of one of the Irâwadi Flotilla Company's steamers at the time of the trouble with Thebaw. He was captured at Mandalay and imprisoned, along with some other Europeans, and for the period of a week he and the others were let out every day to be beheaded, but for some reason or other were remanded to prison. They were of course released when the British forces came up. The strain was too great for one of the unfortunate victims, who went mad before being released.

The Bazaar is interesting, and a very good idea can be got of the Burmese women who sit beside the wares they have to sell; they know well how to bargain. Burmese silks and silver articles of all sorts are sold here; but as the plague was raging in the city at the time, the bazaars were in a great measure deserted. One of the most interesting sights in the outskirts of Mandalay is the Kutho-Daw, or Buddhist Library, so-called. This is an immense square surrounded by a wall, with rows on rows of white shrines inside, inside each of which again are tombstone-shaped slabs of granite, engraved on either side with writings from the Aphitama, and the other three divisions into which the Pitagat or Buddhist Bible is divided. I was presented with a copy of this written on rice paper in Burmese characters by one of the American

missionaries of Hsipan, one of the most learned men in his knowledge of Burmese in the country. The monks are supposed to come here for study, but during our visit the only creature we could see there was a small native child.

The heat in Mandalay we found very trying through the day, though not at night. The situation of Mandalay at the foot of the Northern Shan Mountains, and close to the Irâwadi, is a grand one, and there is great room for expansion, though the distance from what is called the

FIG. 2.—Forest scene in the Northern Shan States.

"Mandalay shore" of the Irâwadi is inconvenient. When the Northern Shan State Railway reaches Kunlon, on the banks of the Selwin river on the southern Chinese frontier, as it will do soon, and is linked up with a railway into the province of Yunnan, Mandalay is sure to benefit by it. The mistake the government seems to have made was the building the railway on too narrow a gauge, and for the sake of shortening the distance into the Northern Shan States making two reversing stations where none need have been if the line had been lengthened out a little. The rise to Maymyo, a kind of sanatorium and military station, is 3481 feet, and is very steep. After the higher ground is reached the rail goes right on without a break. Lovely views of the

low country west of Mandalay are obtained at the reversing stations as the train ascends. Maymyo is the place the morning trains from Mandalay stop to give passengers time for breakfast. As a sanatorium Maymyo is not to be compared to Nuwara Eliya, in Ceylon, or Coonoor or Otacamund in the Nelgherries, the elevation is insufficient, and there is a want of water about it. But still it is a relief from the hot, low-lying plains around Mandalay. From Maymyo the line descends through a well-wooded and pretty country like the lower hill country of Ceylon, to the stations of Wetwun and Hsum Hsai, and then again ascends to Nawnghkio, 2722 feet. Thence it drops to 2200 feet at the great Gokteik viaduct, forty miles from Maymyo, where there is a huge iron trestle bridge a quarter of a mile in length spanning a deep valley (see Fig. 3). This great bridge looks, when seen from a distance, like a gossamer web, though it is in reality a very powerful structure, and made for a double set of rails should these ever be required. We put up at the Travellers' Bungalow, which is a very substantial building high above the station, with bedroom accommodation for a party of seven or eight persons or more if they bring their own bedding, as is the custom in Burma and India. Accompanied by the stationmaster, a kindly Madrasse, I walked along the bridge, which is some 900 feet above the level of the river, a tributary of the Irâwadi, which flows down the valley, but is here underground. No water runs below the bridge, the river having worn a passage in the distant ages through the limestone rocks some 500 feet below the ground on which the trestles rest. From the roadway of the bridge one looks down on a sea of green jungle, with a glimpse of the river far below where it enters the cavern or underground passage. Getting a coolie guide from the stationmaster the following day, we descended through the forest to the river. The path winds down the face of the limestone rocks till it reaches the river, which we crossed by means of a rough wooden spar bridge to the left bank, and then by little bridges of spars we worked our way through water and boulders, and finally descended by means of very rickety ladders, into the cave through which the river runs below the railway viaduct. It is a wonderful sight to see the river suddenly disappearing underground into what looks like a black chasm. Looking up before entering the cavern, one sees the bridge like a thread 900 feet above the river. It is a weird and awe-inspiring sight, the sides of the limestone cliffs being absolutely perpendicular at this point. We followed the river through the cavern on a sort of elevated shelf on the left bank, which at that time was not flooded with water from the river, till we could see a glimpse of light where the river leaves the cave on the other side. The cavern itself is full of stalactites and stalagmites. These latter have assumed all sorts of fantastic and weird shapes, some of them not unlike sitting Buddhas. In some places the water comes from the roof in a regular spout or douche, and in others like a shower bath, necessitating our wearing waterproofs and holding up umbrellas. The average height of the passage is about 20 feet above the river, rising to 30 feet at the entrance. The river from the railway bridge looking down seems quite small, like a thread of water, but it is in reality a

considerable stream, and in the rainy season must rise to very large dimensions, making entrance to the cavern impossible. The Gokteik is a very strange and probably unique sight in Burma or India. Immediately after leaving the bridge the railway enters a tunnel cut through the limestone rock, and a little further on into another. We were told that the rocky nature of the country here, which is all jungle, makes it a favourite resort for bears, and one had been shot close to the viaduct

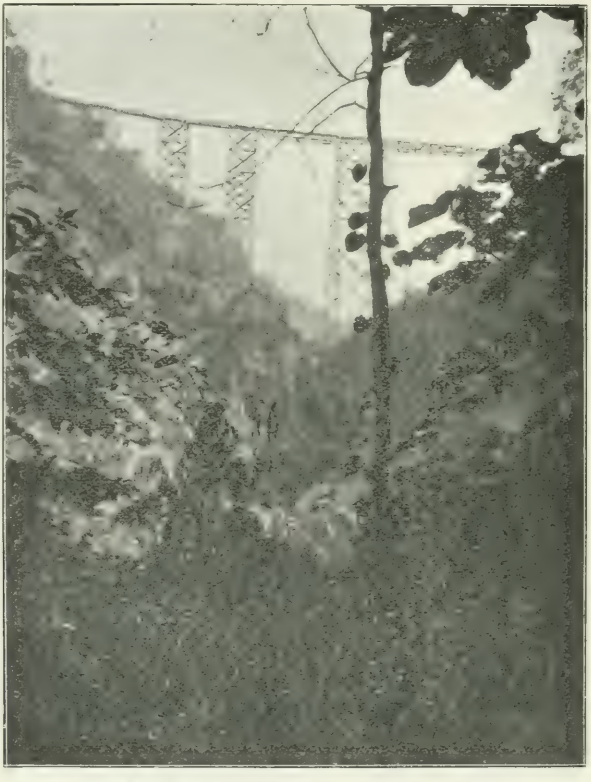


FIG. 3.—Gokteik Viaduct, Northern Shan States.

recently, but all we saw were some large black monkeys disporting themselves in the forest.

From Gokteik we went on through a mountainous and well-wooded country, with native villages and small paddy fields here and there, to Hsipaw right in the heart of the Shan country. We found the Dak Bungalow there a long way from the station and difficult of access in the dark, but by the kindness of one of the American missionaries stationed at Hsipaw a number of native Christian boys put our luggage on a bullock cart and took us there. We found the bungalow occupied by the brother of the reigning chief or Sabwa and his numerous wives and family. It seems he had fled thither on account of the plague, so we quickly returned to the station and made use of our railway carriage and

a room at the station as a resting-place. Next day we went in the morning to see a native Christian service conducted by a Burmese (Karēn) Baptist minister in Burmese. The station is one of many occupied by the American Baptist Mission, and many native youths have taken advantage of the good education offered to them. The bazaars at Hsipaw are kept by Burmese and Chinese respectively. We were able to purchase here two of the enormous sun-hats used by the Shan women as a protection against sun and rain. Hsipaw being so near the Chinese frontier at Kunlon, where the railway is to be carried eventually, there are many Chinese at all the stations betwixt Maymyo and Lashio, the present terminus of the line. The Shans, though small in stature, are a most robust and healthy-looking race, but quite distinguishable from the Chinese. At Hsipaw we came in for an eclipse of the sun, which kept the sun's rays in check and made it delightfully cool travelling. We did not visit the Burmese Ruby Mines, which were said to be about forty miles off through a very difficult country. If any one wanted to economise, living is cheap in those parts, and a house can be built of bamboos well raised on posts above the ground for a few pounds. At Hsipaw there is a Resident of the Indian Government, and the reigning prince or Sabwa, and the American Missionary, but no other Europeans.

Returning to Mandalay, we embarked one evening in the Irâwadi flotilla's steamer, the *Momein*, for Bhamo, along with a few English passengers and crowds of natives of all sorts. Before setting sail, and just when the steamer's electric lights were turned on, a dense swarm of winged white ants alighted on the ship and kept pouring down in an incessant stream for two hours, principally round the electric lights. They were so bad it was found impossible to open one's cabin door, otherwise the cabin would have been flooded with them. At certain times of the year they are very troublesome in Ceylon, even flying into one's soup at dinner, but I never saw them so numerous as here. Before entering my cabin I had to get the deck light close to it turned off, when they betook themselves to other lights. After the steamer got under weigh they disappeared, but not till they had littered the deck below the lights to a depth of six inches. In the morning several bushels of them were swept up and thrown into the Irâwadi.

The Irâwadi is a mighty river, and at Mandalay runs with a strong current, the course of the steamer being marked by anchored poles. In January, the time we were there, the volume of water goes down, as there is no melting of the snow in the mountains of Tibet. In March the river begins to rise again. A little above Mandalay on the right bank we stopped for a short time below the ruined pagoda of Mingun, a huge building begun by King Bodoahpra, 1790, where the largest bell, and probably the biggest building of brick and mortar in the world, is to be seen. The bell is said to weigh about eighty or ninety tons! The pagoda was badly shaken by an earthquake long before the British occupation of the country. There is a distant view of the Shan Hills to the south-east of the river, but on the north the hills are low. There are most lovely spots every here and there, with pagodas and houses amongst the cocoanut groves. The mail passenger

steamers use the limelight, and do not require to anchor at night except in the case of fogs. We stuck twice the second day out from Mandalay, once for two or three hours, and again for four or five hours. The most lovely views of the Shan Hills were seen during this day's journey. The following day we ran into quite an unexpected light, misty rain, which did not last long, and was the first that had fallen since 1st August. This day we passed the steamer *Mandalay* fast aground in the sand at a wide part of the river. We stopped for about an hour at a village called Tgyaing, where we landed a number of native passengers and cargo. Tgyaing (once a place of note) is a large fishing village with pagodas and bungalows on a hill overlooking the river. Great crowds of

Fig. 4.—Second Defile on the Irâwadi River.

Burmese lined the banks, looking very picturesque in their red, white, and coloured cloths, with pink handkerchiefs tied round their heads in a fashion that always marks off a Burman from the natives of India or China. The arrival of the steamer being the event of the day doubtless brings the villagers about, especially if there is any business to be done, but being a reticent people they do not force themselves before people. Baskets of fish like carp and perch were offered for sale. There are several wide reaches of the Irâwadi here favourable for fishing purposes. All day we had grand views of the mountains clothed with forest to their summits. The next station of importance on the river we reached was Katha, where a branch line comes from Naba junction, on the main line from Sagaing to Myitkyina, so that passengers taking the railway from Sagaing opposite Mandalay can come here by rail and join the

steamer for Bhamo, or *vice versa*. Owing to a dense mist setting in after leaving Katha we had to spend the night anchored, and did not get off till 8 A.M., soon after arriving at the village of Moda on the left bank of the river, and about 2 P.M. we entered what is called the second defile (see Fig. 4), the first defile being on the river above Bhamo. The river here is not more than two hundred yards wide, running betwixt beautifully wooded hills. On the left bank of the defile we passed the wreck of a steam-launch which had belonged to King Thebaw, and had been lying there ever since his and the queen's deportation to India. At one bend of the defile a huge cliff rises on the right bank to a height of some eight hundred feet, with absolutely precipitous sides. The whole defile is exceedingly grand and wild. Every here and there could be seen long boundaries cut in the forest, down which timber is brought to form rafts for floating down the river. Some of these rafts have regular small houses built on them, where the men in charge live till they take the raft down to Rangoon. As the distance from this part of the river is 1000 miles, it must take them months to reach Rangoon.

Before reaching Bhamo the Irâwadi opens out like a lake. Under the red glow of the setting sun it looked exceedingly beautiful, being backed by a huge range of mountains, along which is the boundary between Upper Burma and China (Province of Yunnan). Bhamo is on a bend of the left bank of the Irâwadi, and is well situated for extension, but having so much water around it, it is subject to dense mists at times, which stops all navigation for hours. We drove on landing through the bazaars, crowded with very respectable, well-clothed Chinamen, some speaking English correctly, not pigeon English, and many wild-looking men from the border mountains, Kachins and Shans. We entered a large Chinese joss-house which looked very weird in the dusk of the evening. There were many figures of Phongys (monks) and Buddhas in this place.

We did not ascend the river through the defile to Myitkyina in the north, the present terminus of the railway in that part of Upper Burma, as the water in the river had got too low for anything but small steamers. In January the temperature at night in these latitudes is exceedingly cold, the cold being aggravated in the river by the dense mists that prevail; but during the day the sky is beautifully clear and the heat great from noon till 4 P.M. A good sun-hat and umbrella are necessary for walking about.

There is a daily ferry-boat, as it is called, though it is a fair-sized steamer, running betwixt Bhamo and Katha for those taking the railway from Katha, either north from Naba junction to Myitkyina or south to Sagaing opposite Mandalay. The country betwixt Katha and Sagaing is all jungle and is sparsely peopled; it looks as if there was room for a much larger population.

Sagaing, one of the ancient capitals, was established in 1300 A.D., on the right bank of the Irâwadi. There are many interesting pagodas here, but all in a more or less dilapidated condition. There is one large abandoned pagoda built by one of the kings, the Kaung-hum-dun. The story goes that when the king resolved on building it, the

architect asked what shape he wanted it. The king said his wife's breasts were the most beautiful object he knew, and accordingly commanded the dome to be built that shape, and there it stands till this day, a striking object in the landscape. The country around grows rice well. There is a short line of railway from Sagaing to Monywa and Alon on the Chindwin river, which cuts off a considerable angle in ascending the river if approached from the north.

When Sagaing was abandoned the king of those days built a new capital on the left bank of the Irâwadi, and called it Ava or Ratnapura (city of gems, Ratnapura being also the name of a town in Ceylon under Adam's Peak, celebrated for its sapphires). The Burma city was founded in 1364 A.D. Ava is all abandoned and overgrown with jungle, and many ruined pagodas are to be seen there. At Sagaing a steam ferry-boat conveys passengers across to Amarapura, another of the capitals of Burma, founded so recently as 1783, six miles north-east of Ava, but likewise abandoned in favour of Mandalay. There are a great number of ruined pagodas in Amarapura scattered over a considerable extent of country and looking very picturesque from the river. Days might be spent investigating these ruins. There is a short line of railway from the ferry to Mandalay, which passes through Amarapura. There is still a village at Amarapura, though its ancient glories have departed.

As the river had on the 20th of January got too low at the Mandalay shore for the larger steamers of the Irâwadi flotilla to run up, the passage to connect with them had to be made in the smaller steamer, the *Onpho*, for eight miles below Mandalay, and transference made into the regular mail steamer, the *Java*. It took us a whole day's steaming to reach the mouth of the Chindwin (waters of infinite calm); but as the water in that river had got so low we had to forgo the ascent. At Myingan a branch line of railway goes off on the left bank and joins the main line from Mandalay to Rangoon at Thazi junction.

It is astonishing the traffic at these river stations. In addition to the piles of paddy lying on the banks there were piles of jaggery (palm sugar) made up in white mat packages, so large that it took two men to carry one on board, and also great packages of paper made from the inside part of bamboos. This paper is used in the making of the huge cigars the Burmese smoke, men and women alike. There are no quays at the stopping-places on the banks; two or three planks are thrown out from the steamer to the shore, and on these people go out and in. The steamers are usually crowded with natives squatting on the decks, journeying up or down the river, and a regular sort of bazaar is held on board whenever a steamer touches at a village. The first-class passengers' accommodation is on the fore part of the vessel, the second-class at the stern, and the third-class betwixt the two. The native passengers eat and sleep where they squat on the deck, or lie stretched out on a mat or carpet. Whole families are to be seen thus—father, mother, and children, and all apparently as happy as the day is long.

We stopped at Pagān, one of the many old capitals of Burma, which had its origin long before Buddhism was established in the land. I landed for a short time, wading through the hot sand on the river side till firm ground was reached. I saw a well-kept pagoda with two white figures of Buddhas in front, all of comparatively recent origin, and this whilst two or three miles off are some of the grandest old pagodas in the world of the olden times, not in very bad repair even after hundreds of years of neglect. There is a Dak Bungalow here where a traveller, if well supplied with provisions, and a native or Indian servant or two, might spend several days in visiting the ancient pagodas. When looking at such a pagoda as the Ananda, a pile that would rival St. Peter's, it appears inconceivable that such a civilisation as this presupposes should have disappeared so utterly. Steaming down the river, a very good idea of the vastness of Pagān is got. The ruined pagodas extend for a distance of eight miles on the right bank of the Irâwadi. Though all abandoned and grown over with scrubby jungle, the mighty shrines glittering in the afternoon sun would almost convey the impression that the plain was still inhabited. Pagān came to an end through the Mongul invasion in the fourteenth century, when Sagaing became the capital.

Soon after passing Pagān we came to the first series of wells of the Burmah Oil Company, on the opposite side from Pagān. One of our principal objects in the downward journey was to visit the oil-fields. Next to rice cultivation, probably oil is one of the great products of Burma. At Zigat the first wells are seen. The country is hilly, but bare and sandy, and on each little hill a huge derrick marks the site of a well (see Fig. 5). The principal wells are, however, lower down on the left bank of the river, and some little distance inland. The steamboat station for the oil-fields is called Yenangyaung. Then at Yenanghat we were transferred from the mail boat to the steamer of the Burmah Oil Company, and taken to the headquarters bungalow of the manager. There are a number of bungalows for the English and American employees of the Company high above the river, commanding lovely views of the plains and mountains in the west towards the Arakan district of Burma. The following morning, some on ponies, some in a buggy, we set off to ride the six miles betwixt the headquarters bungalow and the oil-fields proper. The country here and for miles round, except in the nullahs, was at that period of the year (January) very dry and parched up. Small scrubby trees of a deciduous sort are scattered about. It looks as if Nature had not intended this country for agricultural purposes. I think I never saw such a broken up country, though not made so by the hands of man. Deep nullahs run in all directions, some so deep that long wire-rope bridges have had to be constructed to span them, carrying the oil pipes from the wells to the red-painted iron tanks where the oil is stored. On every little hill there is a derrick marking the site of an oil well. Some of these wells had to be bored to a depth of 1000 feet. The Company's wells only are marked thus, and are spread over a wide area of country interspersed with native wells of no great depth (30 feet at the most), the oil having been worked by them for a hundred years and more. It

was impossible for the British Government in fairness to ignore their rights. The Company have at one spot an oil exchange, and here on certain days an official of the Company attends and buys the crude oil from the natives, who seldom draw more out of their wells than one or two gallons per day. We saw at one of the Company's original wells the oil pouring out into the tank in a continuous stream. The oil in its crude state is of a blackish green colour. We were shown one well where the oil, when first struck by the borer, spouted up into the air much as one reads of it doing at Baku, and overflowed away into the hollows, where by damming up it was afterwards secured. This well gave in one day the almost incredible amount of 14,000 barrels of crude oil, equal to 560,000 gallons, and it still continues to give a

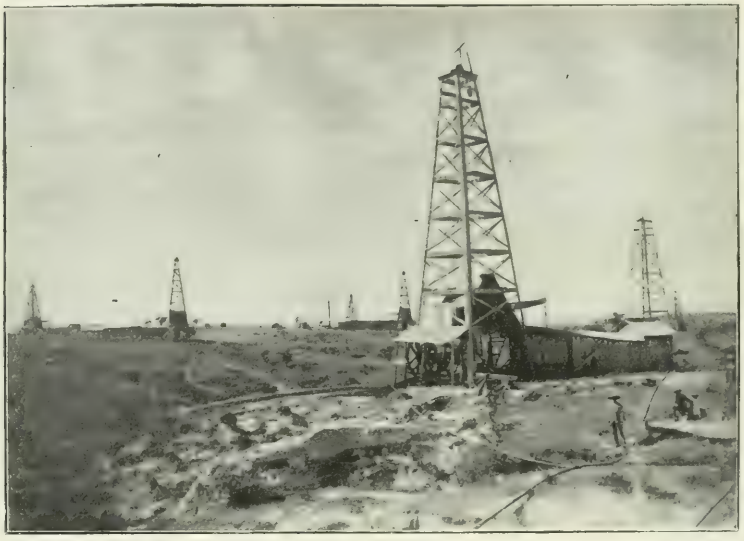


Fig. 5.—Burma Oil Fields.

good return. The chief managing engineer, a very clever American, informed us that there were in this oil-field 180 wells belonging to the Company. The engineers in charge are all Americans from Pennsylvania, where they understand better about boring machinery than our engineers. They said there was nothing like this oil-field in the States. Of course the whole 180 wells are not constantly in working, and some have dried up, but whether temporarily or for good it is difficult yet to determine. The oil goes down in pipes from the tanks at Yenangyaung to the tanks at Yenanghat, on the river, whence it is shipped to Rangoon to the Company's refineries. But all that is to be stopped, as pipes are being laid for a distance of over 200 miles direct from the tanks to the refineries at Syriam—a mighty undertaking.

At Yenangyaung we came in for an interesting ceremony, viz. the

funeral rites before the cremation of a Buddhist Phongy (monk) of some note in the district. We went a few miles down the Irâwadi in the Company's steamer to the place the Phwe was to be held, where the villagers of all ages and sexes, from both sides of the river, got up in their best silks, came in boats and on foot, bearing paper pagodas, and imitation elephants and buffaloes, worked by men inside. There was one huge white elephant (imitation). The imitation pagodas were carried along to the place of gathering by the bearers who executed a sort of wavy dance. As there were several English people present, both ladies and gentlemen, the little girls, all in their best silks, with their hair neatly plastered on their heads, came and performed a dance before us. It was wonderful the admirable time they kept and the solemnity of their little faces whilst they danced. After the girls danced, a number of men came and danced, but their dancing was rather monotonous. The ceremony was interesting on account of the crowds of gaily dressed Burmese seen to great advantage under a brilliant sun, with the great river flowing silently alongside. These were all apparently pure Burmese, there being few or no natives of other countries present.

On the voyage down to Prome, one of the old capitals of Burma, established 483 B.C., we observed a distinct broadening of the river. In some places it was half a mile wide, and during the rains of the monsoon it must be much wider. At Minhla, a large village on the right bank, we saw a group of five small pagodas. Below this point the country is better wooded, probably on account of the greater rainfall, as it comes more within the reach of the south-west monsoon.

Prome, though a very ancient capital of Burma, has few pagodas to show. It is noted as the point of departure by railway for Rangoon, and is a rising town of 30,000 inhabitants. The steamers of the Irâwadi Flotilla Company can here be taken to ascend the river to Mandalay, thus saving the long sail round from Rangoon through a comparatively flat and uninteresting country.

We were unable from want of time to visit the other ancient capitals of Burma, such as Thaton, Pegu, and Mergui, all in the southern part of Burma.

The commercial importance of Burma to Great Britain is very great. Her people will not long remain in ignorance, but will, as education advances, doubtless take their place as one of the great races of the East.

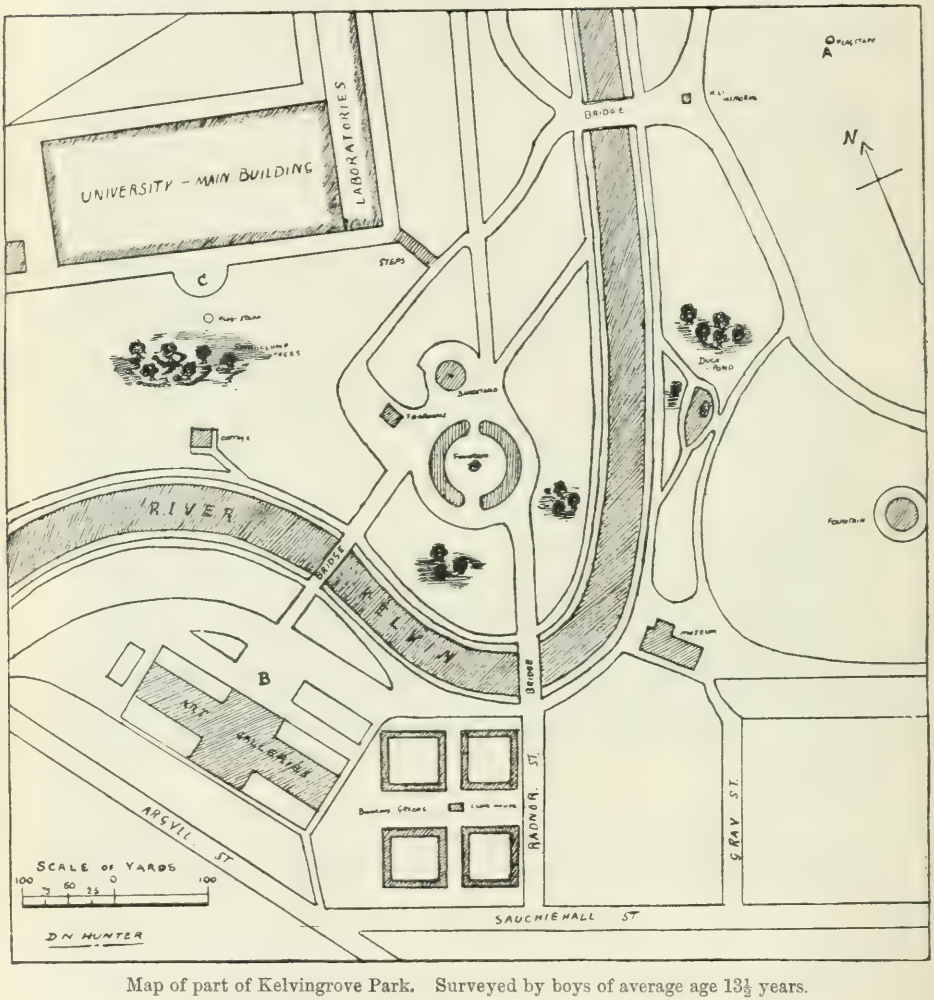
PRACTICAL SURVEYING IN SCHOOLS.

By Frederick Mort, M.A., B.Sc., F.G.S.

(*With Sketch Map.*)

The importance of Geography as a school subject and the desirability of teaching it in a concrete, interesting and scientific way may now be admitted as established. Two of the main difficulties yet to be removed, however, are the beliefs, first, that many of the new methods are above

the heads of young pupils, and second, that the results obtained are not proportional to the additional skill and trouble demanded from the teacher. This Society may therefore be interested in seeing the actual result of a piece of outdoor mapping by boys averaging about thirteen and a half years of age. From beginning to end the work was done



Map of part of Kelvingrove Park. Surveyed by boys of average age 13½ years.

entirely by the boys themselves, and even the final drawing of the map for reproduction in this *Magazine* was carried out by my young friend and pupil, Master David Hunter, fourteen years of age.

The area chosen to be mapped was part of Kelvingrove Park, Glasgow. The apparatus used was the plane-table, the principle of which is generally well known, so that I shall give no description of it. The table was set up at the station marked A and the directions of all the

important points were sighted and drawn, including both ends of the bridges across the Kelvin, in order to determine the course of that river. The table was then shifted to station B, and the same points sighted again and therefore fixed. Station C was used as a correction for the points obtained at B and A, and also for some other points invisible either at B or A. The main points of the map were now determined, and it only remained to fill in details. Several copies of the map in its unfinished state were made and copies given to about half a dozen pairs of boys. Each pair was allötted a portion of the Park and had to draw in the roads and paths of that portion. The directions of the main roads and bridges were checked by another party using the prismatic compass. While one set of boys worked the plane-table, another went to the edge of the river and, using a simple form of sextant, determined its width. A copy of the finished map was then made and coloured by each boy, the river being coloured blue, the grass green, and the paths brown.

The interest taken by the pupils in this task was considerable, and for this alone I consider the value of the work was great. In addition, they replaced a vague idea of the park surroundings by a clear and accurate knowledge of several important geographical facts and methods, and this, moreover, was obtained by their own efforts. They were thrown to a large extent on their own resources; entirely so in the case of the pairs surveying the paths. The result I consider very creditable to the boys, and it shows that if once their interest is aroused and their hearty co-operation obtained, work of no mean value can be produced. It should be added that their training in the school (Allan Glen's) is largely in a scientific curriculum, and therefore the ability of the boys to handle a new piece of apparatus was probably greater than the average.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meetings of Council.

At a Meeting of Council held on the 12th November 1907, the following ladies and gentlemen were elected "Teacher Associate" Members of the Society:—

Miss Sara Corner, M.A.	Miss H. Sh. Divorty.	Miss H. Picken.
Miss Margaret S. Ross.	Miss M. Somerville.	Miss Robertson.
William Duncan, F.E.I.S.	Miss M. E. Lippe, LL.A.	Miss E. Horne.
Miss A. T. Cowe, M.A.	Miss Agnes Robertson, M.A.	

At a Meeting of Council held on the 21st January, the undermentioned ladies and gentlemen were elected Members of the Society:—

Prof. J. G. MacGregor, LL.D.	Robert Jamieson.	W. W. Ferguson.
James Alexander.	Miss Imlach.	James G. Porter.
Miss J. Bell.	Andrew Watt, M.A., Sec. Scot. Met. Soc.	David M'Nally.
Miss M. T. Blair.		Miss Usher.

John P. Copland, M.I.C.E.
John Dalziel.
Miss B. B. Bird, M.A.
Frederick Mort, M.A., B.Sc., F.G.S.
Miss Helen D. Buchanan.
Major-General Sir A. J. F. Reid, K.C.B., M.A., LL.D.
Miss Jessie Barron, M.A.
James Fulton.
William Pringle.
Adam Watt.
John W. Robertson, M.D., C.M.
A. N. Lindsay.
Robert Lang, M.I.Mech.E.
Fred. J. Pack.
Hugh M'Coll.
Frank Mills.
Rev. John Kelman, D.D.
David Gentle, M.D.
Thomas Graham.
Mrs. Gibbon.
Ralph W. T. Walker.
Mrs. Ralph W. T. Walker.
J. T. Ewen, H.M.I.S.
J. Hamilton Birrell, M.A.
John C. Ferguson, B.A., Ph.D.
William Mitchell, S.S.C.
J. Harvard Biles, Jr.
Alexander Marr, J.P.
J. C. Kennedy.
L. Williamson.

The following were elected "Teacher Associate" Members:—

Alexander M'Callum.
James Mair, B.Sc.
Miss Mary N. Allan.
J. W. Stones.

Diploma of Fellowship.

The Honorary Diploma of Fellowship was conferred on Lieutenant Boyd Alexander (late Rifle Brigade) in recognition of his explorations in Central Africa.

The Council also conferred the Ordinary Diploma of Fellowship on Captain Chas. H. Brown, James Boyd, L. Williamson, and J. B. Richardson, Members of the Society, subject to their compliance with the prescribed conditions.

Society's Silver Medal.

The Council awarded the Silver Medal of the Society to Mr. George G. Chisholm, M.A., B.Sc. (Edin.), F.R.G.S., for distinguished services to geographical education. The medal was presented at Mr. Chisholm's lecture in Edinburgh on the 29th January.

Lectures in February.

Mr. A. Watt, M.A. (Edin.), F.R.S.E., Secretary of the Scottish Meteorological Society, will address the Society on "The Climate of the British Isles." The address will be delivered on the following dates: Edinburgh 19th, Glasgow 20th, Aberdeen 27th, Dundee 28th February. Miss Mary Hall will lecture before the Aberdeen, Dundee, Edinburgh and Glasgow Centres, on the 18th, 21st, 26th and 27th respectively. The subject of her address will be, "A Lady's Journey from the Cape to Cairo." The lecture will be illustrated with lantern views.

Duke of the Abruzzi.

On the 20th December, the Members of the Glasgow Centre of the Royal Scottish Geographical Society were received in the Council Chambers by H.R.H. the Duke of the Abruzzi, to whom they presented an address. The company included Lord Provost Sir William Bilsland, Bart., Dr. Robert Gourlay, Professor Medley, and others.

Dr. Paul Rottenburg, Chairman of the Glasgow Centre, had the honour of presenting the address, which was in the following terms:—

To His Royal Highness Prince Luigi Amedeo Giuseppe Maria Ferdinando Francesco, Duke of the Abruzzi.

May it please your Royal Highness,—We, the Royal Scottish Geographical Society, welcome your Royal Highness's visit to the Clyde and Glasgow as an opportunity to give expression of our keen appreciation and unqualified admiration of the eminent work achieved by you at so early an age in the service of geographical exploration. We would recall your meritorious efforts to conquer the summit of Mount Kangchenjunga, the second highest mountain in the world. We can never forget your Royal Highness's splendid achievement in the scaling of the peak of Mount Elias in Alaska, over 16,000 feet in height, which you were the first to ascend. The fact that your Royal Highness has penetrated nearer the North Pole than any other explorer will at all times—whether or not the final goal be ever reached—count amongst the greatest achievements ever accomplished. Your Royal Highness's ascent of the Ruwenzori Range, the subject of your lecture to the Royal Geographical Society in London, in the presence of His Majesty King Edward, is fresh in everybody's mind, and was commented upon by His Majesty himself in eloquent terms. It will be a memorable day indeed when it may be the good fortune of the Royal Scottish Geographical Society to hear your Royal Highness give their members an account of either past or future explorations. And we pray that your Royal Highness may long be spared and continue with unabated enthusiasm the noble work which has borne already such golden fruit. And we, the Glasgow Centre, on behalf of said Royal Scottish Geographical Society, pray your Royal Highness graciously to accept this address.—Dated at Glasgow this twentieth day of December in the year one thousand nine hundred and seven.

PAUL ROTTENBURG,
Chairman of the Royal Scottish Geographical Society (Glasgow Centre).
A. CROSBIE TURNER,
Secretary.

The Duke acknowledged the address in a few words.

DEPUTATION TO THE CHANCELLOR OF THE EXCHEQUER.

On Monday afternoon, Jan. 13th, Mr. Asquith, the Chancellor of the Exchequer, met a large and influential deputation from the Royal Scottish Geographical Society, at the Society's Rooms in Edinburgh, with reference to the Society's claim for a grant from the Treasury. There were present Mr. J. W. Gulland, M.P., who introduced the deputation, Lord Provost Gibson, Professor J. Geikie, the President of the Society, and a large number of Members of Council, including representatives from Aberdeen, Glasgow, and Dundee, with others. The case for the Society was put forward by Professor Geikie; Dr. Paul Rottenburg, representing the Glasgow Centre; Mr. I. Julius Weinberg, representing Dundee; Mr. William Smith, representing Aberdeen; and Lord Guthrie, one of the Society's Vice-Presidents, who emphasised especially the national character of the Society, and the importance of the work it is doing in Scotland. Lord Provost Gibson also spoke

as representing the Board of Trustees of the National Gallery, and supported the claim of the Society to the consideration of the Treasury in view of the fact that the Rooms hitherto let to the Society by the Board of Manufactures at a very low rent are now required by the Board of Trustees, which has been obliged to give the Society notice to terminate its tenancy in November next.

Mr. Asquith, in reply, said that he recognised to the full the distinguished services which the Society had rendered, and was rendering, and he was most anxious to satisfy himself that no injustice was being done to Scotland as compared with the other parts of the United Kingdom. The claim on the part of the Society for Treasury assistance was not now put forward for the first time. It was a very old claim; it had been considered and rejected by certainly two or three of his predecessors and the Governments to which they belonged, and they were therefore really asking him to reverse a decision taken deliberately. The grounds on which a negative answer had hitherto been given to the appeals put forward on behalf of that and many other societies had been that it had come to be reckoned as the settled rule of successive Governments, in regard to matters of that kind, that State assistance should not be given to societies which rested upon a voluntary basis, in the administration of which the State had no part, unless they satisfied one or other or both of two conditions—namely, that they were doing work which was in relief, as it were, of the State, work which, if it were not done by them, the State would have to do for itself, as for instance in the case of the Meteorological Society, or that they were societies which in the fullest sense represented not one particular part, but the whole of the United Kingdom. It had been the opinion of those who preceded him in the office which he held that their Society did not satisfy those two conditions, and therefore they had refused its claim. He might easily have sheltered himself behind the actions of those who had gone before him if it had not been for the fact that recent events in Edinburgh in connection with their threatened eviction seemed to him to make it necessary to look at the question afresh. It was because of the Government's liberality to the Scottish National Gallery that the trustees found themselves in want of a new home and had fixed upon the Society as the most obvious victims and the easiest persons to eject. Personally he strongly suspected that this was because they were the persons who might have the most plausible claim to compensation from another quarter if they were ejected. He was not in a position to make any definite statement in one sense or the other, but he could assure them that, whatever decision was come to, his sympathy with their aims and his desire that Scotland should receive equal treatment with every other part of the United Kingdom were unabated, and he would do everything in his power to give full effect to his desire. They must, however, allow him to review the situation in the light of the facts which had been brought before him, and he could promise that without undue delay he would communicate the result to the office-bearers of the Society.

On the motion of Sir Colin Macrae a vote of thanks was awarded to Mr. Asquith, and the meeting then terminated.

GEOGRAPHICAL NOTES.

EUROPE.

Plant Remains in the Scottish Peat Mosses.—Mr. Francis J. Lewis has been continuing his investigations on this subject (cf. *S.G.M.*, xxii. p. 241), and has forwarded to us a reprint of a paper read before the Royal Society of Edinburgh last year (*Trans.*, xvli. 1), dealing with the deposits of the Highlands and the Shetland Islands. Mr. Lewis has now examined peat deposits in about twenty-four districts of Scotland, and gives a general summary of his observations. He recognises the following beds:—Upper Forestian, Upper Peat Bog, Second Arctic Bed, Lower Peat Bog, Lower Forestian, First Arctic Bed. Beginning with the lowest of these, the First Arctic Bed, we find that it has only been recognised in the Outer Hebrides and Shetland Islands. It rests upon glacial deposits, and the plants suggest that the surface was then of the nature of an Arctic tundra, with scattered pools containing aquatic vegetation. In the Outer Hebrides the plants are of a less distinctly Arctic type than in the Shetlands, and it would appear that the Arctic plants had barely time to establish themselves in the extreme west before the Lower Forest period supervened. This Lower Forest bed is well marked in the Shetlands, the Southern Uplands, and the Hebrides. The presence of tree remains in the Shetlands indicates that the paths of the Atlantic cyclones must have been different from that prevailing at the present time, for the deposits occur at places where trees will no longer flourish on account of the force of the winds. A very striking feature also is the absence of the distinctively northern plants of the Arctic bed from the Lower Forest bed. The plants growing in the former are those which now occur at a height of 2000 feet on Scottish mountains, and as they then occurred at sea-level the Arctic bed means a lowering of the present alpine-arctic boundary by 2000 feet, and the forest bed its elevation to about its existing height. In other words, there must to all appearance have been a great difference in temperature between the two periods. No trace of Scots pine is to be found in the Lower Forest bed. The Lower Peat Bog bed is widely spread, but tends to thin out when traced from the south to the north, suggesting that the plants forming this deposit invaded the northern part of Great Britain from some point to the south or east. Above comes the Second Arctic bed, which is not recognisable to the extreme west. The Upper Peat Bog bed occurs everywhere, but to the west is continuous with the Lower Peat Bog. The Upper Forest bed is confined to the mainland of Scotland, stretching from Wigtownshire to the valley of the Dionard, south of the Kyle of Durness, and is absent in Shetland. In the south Scots pine constitutes the forest, but to the far north and at great elevations it is replaced by *Betula alba*. During this period the upper limit of trees must have been raised to over 3000 feet above sea-level, or more than 1000 feet above the present forest line. In other words, Mr. Lewis's recent work goes to confirm his previous conclusion that the peat beds support Professor Geikie's view that there was a succession of glacial and inter-glacial

periods; the similar arrangement of the beds in widely scattered areas, and the great differences of climate which the successive deposits indicate, negative the idea that the different beds were produced by mere local variations in their physical conditions.

Asia.

Dr. Sven Hedin's Expedition.—Dr. Sven Hedin, writing from Gargunsa under date November 8, states that he has been down to Nepaul from Tadum, crossing the Pass of Kore-la. The explorer afterwards crossed for the fifth time the gigantic mountain range, about 2000 miles long, from the Salwin to the Panj, collecting valuable details concerning that range.

Dr. Sven Hedin has discovered the true source of the Brahmaputra River—namely, the Kubitsanpo, which rises from an enormous glacier on the northern side of the northernmost parallel range of the Himalayas. The Marium-chu, which has hitherto been regarded as the source, is merely a small tributary flowing in from the west.

After a careful study of the hydrographic problems regarding the Manasarowar and the Sutlej, Dr. Sven Hedin proceeded round the Kailas Peaks, discovered the true source of the Indus, and travelled north-east to the 32nd degree of latitude north.

He is now proceeding to Ladakh and Khotan *viâ* the road running east of the Karakoram Pass. In the spring he will travel either to Pekin or India.

Africa.

Artesian Wells in Algeria.—According to a note in the *Revue Générale des Sciences* much progress is being made with the sinking of wells in southern Algeria, with eminently satisfactory results. During the winter of 1906-7, as a result of the work undertaken nearly 7500 gallons of water per minute were added to the supply available in the territories of Tuggurt, Ghardaya, the Saharan oases and the route between El-Arich and Berguent. This amount of water permits of the irrigation of nearly 2000 acres of palm groves, containing approximately 120,000 trees, and yielding an increase of revenue to the proprietors of some £16,000 per annum, in addition to the value of the subsidiary crops which can be raised in the groves, including forage plants, vegetables, fruit trees, etc. In the oasis of Sidi-Amrane, in the region of the Wad Rir, a well has been sunk which gives the high yield of 2600 gallons per minute, which not only permits of the irrigation of the old palm groves around, but has permitted the formation of a new oasis of more than 30,000 palm trees.

America.

The River Pilcomayo.—We have received from Mr. Gunnar Lange an English translation of his pamphlet on his exploration of the river Pilcomayo from its discharge into the river Paraguay to parallel 22° S. (Meteorological Office, Buenos Ayres, 1906). The expedition was

undertaken in 1905, and had for its object the investigation of the possibility of establishing navigation between the Colony Buena Ventura, on the Upper Pilcomayo, and the Paraguay. The Upper Pilcomayo, as was known before the present expedition, ceases to exist as a well-defined stream in about parallel 24°, and loses itself in the zone of great marshes known as the Estero Patiño. After passing 24° 30′ S. latitude, the waters re-collect in streams to the chief of which, a river debouching into the Paraguay about 5 kilometres from Asuncion, the name of Pilcomayo is again given. As the upper stream traverses the forests of the Gran Chaco, the establishment of navigation throughout the system has long been desired, and, as indicated, the object of Mr. Lange's expedition was to investigate the possibility of this. Before his expedition no one had followed the system completely —either up or down stream—through the great marshes, a feat which he successfully accomplished. The following brief summary gives the salient points as regards the course of this remarkable system.

About 20 kilometres in a direct line from the discharge of the lower Pilcomayo into the Paraguay the adjacent land begins to rise, and from this point to the Patiño marsh the stream is bounded by bluffs and high ridges which separate its channel from the low swampy land in the vicinity which is flooded in times of freshets. Between the two points where large tributaries flow in, known respectively as Junta Fontana and Junta Dorado, the river bed is much obstructed by snags, and throughout all this lower part of the course a considerable augmentation of the volume of the water is observable, due to springs, usually salt, in the bottom and to infiltrations from the banks. At low water the depth of this section varies from 8 to 18 inches. At Junta Dorado begins the great marsh which extends for about 90 kilometres in the general direction of the river. The extent to which this marsh extends to the north is not known, the party having travelled in its southern region. It forms a great horizontal plain, and where its surface has been cut through by streamlets there is always seen an impermeable bed of a calcareous deposit ("tosca"), which doubtless once formed the bed of a vast shallow lake, which was gradually filled up by river-borne detritus. The lower Pilcomayo takes origin in the south-eastern part of this marsh from surface rills about 7 kilometres upstream from Salto Palmares. These rills unite and form a gradually deepening channel which becomes the river. This stream shows a constant tendency to work its way to the north-westward. The Arroyo Dorado, the stream which unites with the Lower Pilcomayo at Junta Dorado, originates further to the south in the same marsh in the form of springs or "well-eyes," lying at the bottom of circular depressions with perpendicular walls 3 to 4 metres deep. This river is, however, more or less indefinitely continued to the west by channels, dry except at the flood season. The Arroyo Dorado proper does not, however, again reappear until Calda is reached, this being the western extremity of the marsh. Further to the west the river again loses itself in marshes in years of little rain, to reappear further again to the west before its final source in the marshes to the west of Soret Satandi. It seems

possible that at some remote date the water of the present Pilcomayo flowed through the Arroyo Dorado.

If we now turn to the consideration of the upper Pilcomayo we find that, after crossing the Bolivian frontier, the river runs in a well-defined channel down to Soret Satandi, and then passing to the east it loses itself in the great lagoons of Escalanto, and reappears only to again disappear in the Estero Patiño, whence, as indicated, its waters are finally re-collected to form the lower Pilcomayo.

As to the practical results of the expedition, up to Junta Dorado all that is necessary is the clearing away of snags, the rectifying of curves, and the construction of dams and locks to keep back the flood water and ensure a constant navigable stream. Above Junta Dorado it is necessary to construct canals to bring the waters of the lower Pilcomayo into constant connection with those of the upper Pilcomayo avoiding the marsh, and for this purpose it is necessary to utilise in part the Arroyo Dorado tributary. The total outlay for all the necessary works is estimated by the author at less than half a million sterling.

The paper is accompanied by an atlas of maps which enable the reader to follow in detail Mr. Gunnar's journey, and also his proposals as regards the works which he recommends should be undertaken.

Polar.

Mr. Shackleton's Antarctic Expedition.—Mr. Shackleton left England at the end of October for Lyttelton, New Zealand, which was reached safely. The *Nimrod*, with the complete party on board, left this port for the south on the first day of the New Year, and had an enthusiastic send-off by the townspeople. Just before leaving, Mr. Shackleton sent the following cablegram to Sir John Murray:

"Christchurch, 1*st January*.

"*To Sir John Murray, Challenger Lodge, Edinburgh.*

"Just sailing. Wish send you greetings. Hope in humble way to follow your great work, and do something to be appreciated by scientific world.—Shackleton."

To this message Sir John Murray sent the following reply:

"*Shackleton, Christchurch, N.Z.*—Happy New Year. *Bon voyage.* Safe return.—Murray."

Just before sailing, Mr. Shackleton announced that he had increased his landing party from twelve to fifteen, by the addition of Prof. David of Sydney University, and two graduates. A further message near the end of January announced that the *Koonya* had returned to New Zealand, after having towed the *Nimrod* to the edge of the pack, which was reached on Jan 15. All were well on the *Nimrod* at the date of parting, and the vessel had proved herself a splendid sea-boat in very adverse circumstances.

Both in Australia and in New Zealand, Mr. Shackleton had an excellent reception. At Melbourne he addressed a large meeting under the auspices of the Royal Geographical Society of Australasia, of which Society he was made an Honorary Member.

New French Arctic Expedition.—Particulars are now available of an expedition which is to start shortly, under the leadership of Captain Benard, for the seas round Novaya Zemlya. The ship of the expedition is called *Jacques Cartier*, and is of the type of the French fishing schooner, specially strengthened to resist ice pressure. It has been built at Dunkirk. The expedition is being arranged by the Oceanographical Society of Bordeaux and the French Maritime League, and does not aim at breaking the polar record, but at the investigation of economic possibilities in the Arctic region, as well as at oceanographical work. The party is to consist of a mining engineer for geological and mineralogical work, two naval officers, one for the astronomical, hydrographical, and magnetic branches, and another for meteorology, geo-physics, etc.; also a chemist and a biologist.

It is hoped to make a start in the early spring and test the instruments in the course of a voyage up the coast of Norway, by Bergen and Tromsoe, then to Alexandrowsk and Archangel, and onwards to Kolguev Island. With the beginning of summer a voyage will be made across Barents Sea, both for oceanographical work, and especially for the investigation of the fisheries, which it is believed will be found to be rich off the banks. As soon as the west coast of Novaya Zemlya is free from ice a party will land to study the minerals of the mountains. As the chain is believed to be the continuation of the Urals, it is hoped to find rich mineral deposits. The flora of the islands will also be investigated, and special attention will be given to the question of the occurrence of suitable harbours. In the vicinity of the strait between the northern and southern islands (Matochkin Shar) a house will be built to form a permanent station for future scientific investigations. The rest of the season will be spent in the investigation of the Kara Sea, about which little is at present known, and in the study of glaciology, as well as of magnetism, meteorology, etc. The programme is thus extensive.

The French Antarctic Expedition.—Dr. Jean Charcot's new Antarctic expedition (*cf.* vol. xxiii., p. 491) is making good progress. It is expected that a start will be made next July, and three years' provisions are to be taken, though the intention is only to be absent two years. An important part of the equipment will be motor-sledges, which are being presented to the expedition by the Marquis de Dion. Experiments will be made in the Alps with these sledges during the present winter. The ship of the expedition is being built at St. Malo, Dr. Bruce of the Scottish Oceanographical Laboratory having been consulted in regard to the plans. She is to be specially strong in order to resist ice pressure, and will be of barquentine rig, with compound engines of 550 horse-power. She is to be 135 feet in length, with a beam of 30 feet, and will carry 230 tons of coal and 100 tons of provisions. The crew will consist of twenty-two men. The scientific staff, in addition to the leader, will consist of three naval officers, two zoologists, one geologist, and one physicist for magnetic

and photographic work. The plans of the expedition were outlined in our previous note.

Belgian Expedition to the Arctic.—It is announced that the Belgian Government proposes to send a meteorological expedition to the Arctic next summer. The expedition will be under the command of M. Georges Lecointe, director of the Royal Observatory at Uccle.

The Proposed Argentine Meteorological Station on Wandel Island.—Regret will be felt at the news of the wreck of the *Austral* (cf. p. 38), the vessel which was taking a party and instruments to set up a meteorological station on Wandel Island. The wreck took place very soon after the vessel left port, and as all the valuable meteorological instruments were lost, the establishment of the new station will be delayed for at least a year. The *Austral* was formerly the *Français*, the vessel of Dr. Charcot's Antarctic expedition.

EDUCATIONAL.

THE following announcement will be read with the greatest satisfaction by all persons interested in the progress of Geographical Education in Scotland:—"At a meeting of the Edinburgh University Court, held on January 20th, Mr. George G. Chisholm, M.A., B.Sc., Lecturer on Geography in the Birkbeck College, London, was appointed Lecturer on Geography in the University, as from 1st October next."

The establishment of the new lectureship has been largely due to the persistent efforts of the Royal Scottish Geographical Society, and it is hoped that at an early date the lectureship may give place to a professorship.

Mr. Chisholm, the new lecturer in geography, was educated at Edinburgh University, where he graduated both in Arts and Science. He is the author of a number of important geographical works, notably of the *Handbook of Commercial Geography*, the standard work on the subject, of Longman's *Gazetteer of the World*, and of the two volumes on *Europe* in Stanford's *Compendium of Geography and Travel*. Both as examiner and as teacher, Mr. Chisholm has been extensively connected with geographical teaching in the University of London, and he has also held the post of examiner in geography at Victoria University, Manchester, and at Cambridge. Mr. Chisholm lectured before our Society at the end of last month, and his presidential address to Section E. of the British Association meeting at Leicester appeared in our issue of October last.

We have received an interesting little pamphlet by Mr. H. J. Mackinder, entitled *The Development of Geographical Teaching out of Nature Study* (Philip and Son, 6d. net), which treats of the difficult and much-debated problem suggested in the title. Most teachers are

probably agreed that Nature Study should be the beginning of geography, but practically the best way of avoiding an obvious gap between the two has always been more or less of a difficulty. Mr. Mackinder emphasises the fact that nature study is and must be the introduction to more subjects than geography alone, and then proceeds to discuss the question how the teacher of the former subject may best leave what he calls "tags," to be taken up later by the teacher of geography in the strict sense. In the first place, he suggests that the nature study course should include the free drawing of plans, no excessive stress being laid upon accuracy—simple rough plans should be drawn freely and constantly. Second, by means of some form of modelling the idea of land relief should be introduced. Thirdly, through the simple physical experiments of the nature study stage, some idea of the constant changes which land forms are undergoing should be introduced, and with it the greater conception that if at the present time wind and water, frost and heat, are modifying the surface of the land, then the existing forms at any particular period enable us to read the history of the past. Fourthly, the teacher should endeavour by means of stories and readings to give a romantic and dramatic picture of the inhabitants and conditions of the different parts of the globe, teaching at the same time the names of the different regions but without the use of maps, to whose use Mr. Mackinder is strongly opposed in the case of young children. Finally, without globe and without map, keeping "the imagination on the scale of the real things," the teacher should endeavour to give an idea of the world as a globe, and with it the elements of orientation. When all this has been done, when the child can draw a simple plan, can model so as to get the idea of relief, has realised to some extent the constant changefulness of nature, knows something of the great contrasts of the world's surface, and has some conception of the round world, real geographical teaching may begin. Here Mr. Mackinder would begin first with a blank globe, introducing upon it the home area as a point, and transferring to it from the heavens the directions of north and south. The next point is to introduce globes or balls with the continents in solid white and the oceans in black, but without names. On these the chief lands and oceans should be learned, the home should be localised, and from it the directions of north and south, and the position of the poles. While this mimic earth should also be used in localising the items of geographical knowledge previously obtained, constant reference should at the same time be made to the real globe, and to the position of countries relative to the actual position of the pupils at the time of the lesson. The children should be then instructed to draw outline maps from the globe, and should not be shown printed maps until this has been done, and should also model the continents and draw their models. While practical teachers may perhaps differ in details from Mr. Mackinder as to the best methods of approach with young children, and modifications may have to be introduced to suit the varying conditions of school life in different circumstances, the emphasis laid throughout on the importance of using geography as a means of training

the imagination, no less than the detailed suggestions as to connecting up the subjects of geography and nature study proper, are worthy of the most careful attention of teachers.

NEW BOOKS.

EUROPE.

Das Mittelmeergebiet. Von A. Philippson. Zweite Auflage. Leipzig: Teubner, 1907. *Price* 7 *marks.*

We published a long review of this book on its first appearance (see vol. xx., p. 383), and as this new edition only shows certain minor alterations, we must confine ourselves here to giving a mere notice of its appearance, and to offering our congratulations to the author on the rapid sale of the first edition.

Switzerland: Handbook to the Montreux-Bernese Oberland Railway. By Alfred Ceresole, with Photographs by Fréd. Boissonnas. "Illustrated Europe" Series, Nos. 186, 187, 188. Zürich: Art. Institut Orell Füssli. *Price* 1 *fr.* 50.

This little guidebook consists of a series of views and description of the country traversed by the new electric railway from Montreux on the Lake of Geneva to Spiez on the Lake of Thun, which is at present only open as far as Zweisimmen.

Gravesend, the Water-Gate of London, with its Surroundings. By Alex. J. Philip. With Map. The Homeland Handbooks, No. 53. London: The Homeland Association, Ltd., 1907. *Price* 1*s. net.*

Lyonesse: a Handbook for the Isles of Scilly. By J. C. Tonkin and Prescott Row. Introduction by the late Sir Walter Besant. With Map. The Homeland Handbooks, No. 4. London: The Homeland Association, Ltd., 1907. *Price* 1*s. net.*

These admirable little guides set forth the attractions and features of interest in the various "Homelands" which they deal with. They are pleasingly written, charmingly illustrated, and well calculated to invite English tourists to explore their native country before venturing further afield.

Le Lot, Padirac, Rocamadour, Lacave. Guide du Touriste, du Naturaliste, et de l'Archéologue. Par Armand Viré. 87 Dessins et Photographies, 3 Cartes, et 3 Plans en couleurs. Pp. 310. Paris: Masson et Cie., 1907. *Price* 4 *fr.* 50.

The department of Lot is one of the most picturesque regions of France, and abounds with attractions for the tourist and naturalist. There are the subterranean waters of Padirac, the wonderful grottoes of Lacave, together with several charming old towns and chateaux full of interest for the archæologist and artist. This handbook is the latest volume of the *Collection Boule*, a series of guides now well known and much valued by the more intelligent tourists, as well as by students of natural science and archæology.

ASIA.

The Chinese Empire: A General and Missionary Survey. Edited by MARSHALL BROOMHALL, B.A. London: Morgan and Scott, N.D. *Price 7s. 6d. net.*

This volume commemorates the centenary of the foundation of Protestant Missions in China by Robert Morrison. It has a preface by Sir Ernest Satow, G.C.M.G., in which high tribute is paid to the philanthropy, the learning, and the self-sacrificing zeal of the missionaries. There is a historical introduction on Christian missionary work in China, by the editor, and there are special articles on the nineteen provinces of China proper, and on Manchuria, Tibet, Mongolia, and the Island of Formosa. They are written in a liberal and kindly spirit, and the book can be recommended to those interested in the progress of Protestant missionary effort in the Far East. There are no maps in the work itself, but a companion atlas of the Chinese Empire, executed by Mr. E. Stanford, will shortly enhance the geographical as well as the religious interest of this survey of China.

A Holiday in the Happy Valley with Pen and Pencil. By T. R. SWINBURNE, Major (late) R.M.A. London: Smith, Elder and Co., 1907. *Price 16s. net.*

This interesting book on Kashmir opens with an account of the best time to go there and the wardrobe and equipment required. We are also informed of the places where the tourist may most enjoy the Happy Valley. "Gulmarg is the most frequented and amusing resort in summer of the English colony and contingent from the broiling plains of the Punjab. Here the happy fugitive from the sweltering heat of the lower regions will find a climate as glorious as the scenery. He can enjoy the best of polo and golf, and, if he be not a misogynist, he will vary the 'daily round' with picnics and scrambles on foot or on horseback, in exploring the endless beauty of the place. But if Gulmarg does not appeal to him, let him go with his camping outfit to Sonamarg or Palgam—he will find neither polo nor golf, nor the gay little society of Gulmarg, but he will find equally charming scenery and perhaps a drier climate." It is quite unnecessary to take out a large and expensive wardrobe. Cholera belts, however, should on no account be omitted. Amateur artists should be well supplied with brushes and paper—the latter sealed in tin for passage through the Red Sea and India. It would be well to start from England not later than the middle of March, as the Red Sea and the Sind Desert begin to warm up uncomfortably in spring. Any one absolutely ignorant of Hindustani should study an elementary phrase-book on the voyage. "Hindustani is, as a rule, understood throughout Kashmir, and the tradesmen in Srinagar know quite as much English as is good for them."

The author then proceeds to describe the voyage out, the journey from Karachi to Abbottbad, Srinagar, the Lolab and Lidar Valleys, and Gulmarg, and his visit to Delhi, Agra, and Udaipur. The text consists of the author's journal written day by day, but, following a device which is now too much in vogue, the *year* of the author's journey is not given. We presume that publishers hope by this means to lengthen the "life" of a book, but it leads to unsatisfactory results. Thus, when the author (page 236) tells us that the flood he witnessed "has been nearly as bad as the great one of 1903," we naturally desire to know during what year he visited Kashmir.

The author's style is good, his descriptions are entertaining, and the twenty-four coloured illustrations from sketches made on the spot are admirable. He generously remarks that the best book on Kashmir which he knows is Sir Walter Lawrence's *Valley of Kashmir*; but we shall be surprised if his lively and valu-

able volume does not send many a traveller to taste the delights of *The Happy Valley*, of which the author gives a good map reduced by him from the map of the Ordnance Survey of India.

AFRICA.

Murray's Handbook for Egypt and the Sudan. Edited by H. R. Hall, M.A., F.R.G.S. Eleventh edition, revised and augmented, 1907. With 58 Maps and Plans. *Price* 14*s.* London: Edward Stanford.

In order to keep pace with the development of Egypt, the progress of archæological research, and the opening up of the Sudan, many changes have been rendered necessary to bring this well-known guidebook up to date. These changes appear to have been most thoroughly carried out by the editor, Mr. H. R. Hall, who is an acknowledged authority on Egyptian antiquities. The handbook has been largely rewritten, and contains much new matter as well as additional maps.

Baedeker's Egypt and the Sudan. Sixth remodelled edition, 1908. With 24 Maps, 76 Plans, and 57 Vignettes. *Price* 15 *marks.* Leipzig: Karl Baedeker. London: Dulau and Co.

It would be difficult to excel this little volume for completeness and compactness. It is a marvel of careful condensation, and for wealth of illustration in beautiful maps and plans it is certainly without a rival. Compared with the previous edition of 1902, the text has been remodelled, brought up to date and amplified, and various new maps and plans have been added, thereby making it all that the Nile tourist could wish for as guide and travelling companion.

The Egyptian Sudan: Its History and Monuments. By E. A. Wallis Budge, M.A., Litt.Doc., etc. etc. Two vols. Illustrations and Maps. London: Kegan Paul, Trench, Trübner and Co., Ltd., 1907. *Price* 42*s. net.*

Perhaps Mr. Budge has done more than any one to popularise the study of Egyptian history and mythology. Most Egyptologists are so profoundly learned that none but earnest students dare open their books, but Mr. Budge contrives to make these dry bones live. It is true that he sometimes fails to grasp the true spirit of the inscriptions which he translates: possibly, if he bore in mind that the early Hebrew Scriptures were written by men trained in the Egyptian school, he might find therein the key which at present he lacks. Nevertheless, the British public owe him a very considerable debt of gratitude for this, as for his former publications, and we can recommend readers of his previous work on Ancient Egypt, and indeed all who are interested in the subject, to peruse what may be justly termed a compendium.

This is not the place to give a detailed review of such an exceedingly comprehensive work. It is, as it were, several distinct subjects dealt with at once, so that very various classes of readers are appealed to. Historians, antiquarians, geographers, and ordinary travellers and sightseers, are all afforded information of great value, and those who have leisure to study the book on the spot will be very grateful for these closely packed volumes.

Those who cannot visit Egypt will be able to gain a very intimate knowledge of the history and development of that remarkable land, and at the same time will learn much concerning the religion of the people in bygone ages.

The commercial aspects of the Sudan are well dealt with, and the future is forecast in moderate terms. The account of the present condition of the Sudan is

well up to date, and adequate tribute is paid to Lord Cromer, the Sirdar, Slatin Pasha, and those who have rendered their successful work possible. The Gordon College comes in for praise, and the construction of railways, their future, the problem of the Sudd, and the increased water supply for Egypt, are described clearly and with full knowledge.

Altogether, this is a most satisfactory book, and author and publishers can alike be congratulated. The bibliography and index are quite admirable, and the illustrations and maps are excellent.

The Guanches of Tenerife. By the Friar Alonso de Espinoza. Translated and edited by Sir Clements Markham, K.C.B. London : Printed for the Hakluyt Society, 1907.

The latest publication of the Hakluyt Society is a translation of the work of Father Friar Alonso de Espinoza of the Order of Preachers on "The Origin and Miracles of the Holy Image of Our Lady of Candelaria, which appeared in the island of Tenerife, with a description of that island." This remarkable work was first published in Seville in 1594. The present translation is by Sir Clements Markham, the President of the Hakluyt Society, and when we remember that it is now just half a century since the veteran President first appeared as a translator and editor for the Society, we must heartily congratulate the Society and the President on the publication of this work. As is the case in many of the Hakluyt publications, the introduction, contributed by the editor, is much the most interesting, if it be not the most valuable part of the work. From it we learn that this work is intended to be supplementary to a volume issued in 1872 and edited by Mr. Major of the British Museum, in which he gave a translation of the narratives of Pierre Boutier and Jean le Verrier, the chaplains of the French Knight Jean de Betencourt who first attempted the conquest of the Canary group. Betencourt, however, did not attempt the subjugation of Tenerife, the central island, now well known to us, and famous for the snow-clad peak which rises some 12,000 feet above the level of the sea.

The island in the days of Betencourt was inhabited by a race called Guanches, of whom we gather from the interesting and erudite introduction that they "derived their name from *Guan*, a son, and *Chenerfe*, the name of Tenerife, a contraction of *Guanchenerfe*. Their ancestors came, no doubt, from the neighbouring African coast of Mauritania, but long ages before that country was overrun by invaders of Arab or Negro blood. Mauritania was then inhabited by the same ancient Iberian race which once covered all Western Europe, a people, fair, tall, and strong ; a people of many virtues and of few vices."

They are now a lost race, and we are indebted to the Hakluyt Society, and more particularly to Sir Clements Markham, for reviving interest in them by the present publication. For this task Sir Clements had a choice of three Spanish authors, of whom he wisely selected the earliest, viz. the Friar Alonso de Espinoza, who wrote in 1580-90. Evidently the good Friar was a man of deep religious temperament, who, when in the province of Guatemala, was profoundly impressed by the strange story of the appearance of a miracle-working image of Our Lady to the heathen inhabitants of Candelaria in Tenerife ; and he determined to investigate the facts for himself. He went to the island, saw the image, believed the story of its appearance, and was much distressed to find that there was no authorised record of the history either of its appearance or of the miracles it had performed. At first apparently his proposals to put on formal record the history of the image did not meet official approval, but at last he secured

the consent and help of the Provincial of his Order and the Bishop of the island, on which he set about the task of historical investigation in a businesslike way. The Friar's principal object was, of course, the glorification of the image of Our Lady of Candelaria, but, happily for us, he added to his original intention a description of Tenerife and its inhabitants, and an account of its conquest.

He was well aware of the difficulties of his task and naïvely remarks: "The part which treats of the conquest, of the wars and of the conquerors, is partly from what I have heard, and partly from the archives and other writings, with the lawsuits about possessions. It is full, all related, as it took place; and it is not my fault that there are errors, for I was not present when the events occurred, nor is there a man now in the islands who saw them. It is better to have something, though brief and confused, than to leave all unknown." His book is divided into four sections, the last of which, however, has been judiciously left untranslated, as it contains merely a detailed account of some sixty miracles performed by the image.

We have already mentioned that Betencourt did not attempt the conquest of Tenerife. After his death his descendant sold his rights to one Pedro Barba, Lord of Castro Forto. He in his turn sold them to some one else, and ultimately the islands of Canaria, Tenerife, and Palma were bought by King Ferdinand and Queen Isabella for six quintos of maravedis. It was one thing, however, to buy the islands and quite another to subjugate them; and in connection with this it is somewhat astonishing to hear a Spanish Friar, like Alonso de Espinoza, giving vent to the following sentiments: "It is an acknowledged fact, both as regards divine and human right, that the wars waged by the Spaniards against the natives of these islands, as well as against the Indians in the western regions, were unjust and without any reason to support them." In the year 1493 a Spanish knight, Alonso de Lugo, got permission from the King of Spain to attempt the conquest of Tenerife, but he made the not uncommon mistake of underestimating his enemies, and so, in his first attempt, he was badly beaten. Next year, however, he returned with a much more powerful force, and on this occasion it was the Guanches who made the mistake of underestimating their enemies, and in consequence they in their turn were badly beaten. The discomfiture of the Guanches was completed by pestilence and famine, which decimated the inhabitants of the island, and from that time on their power was broken. Under the blight of Spanish government they dwindled away till they became a lost race, of whom only a few traces still remain. The Hakluyt Society has done a good work in thus reviving the story of a brave and interesting race.

Across Widest Africa. By A. Henry Savage Landor. 2 vols. London: Hurst and Blackett, Ltd., 1907. *Price* 42*s. net.*

During 1906 Mr. Landor travelled "across widest Africa," accomplishing the longest trans-African journey that has ever been made from east to west, and considering the time he spent at various places of interest and the amount of information he gathered on the way, the journey of 8500 miles was made in the excellent time of 364 days. Starting from Jibuti he passed through Abyssinia, struck the Nile near Sobat, continued south-westwards towards the Quelle River and Banzyville, thence north-west to Lake Chad, and from that westwards by Timbuctu to Cape Verde. The result is two handsome volumes full of illustrations, statistics, details as to peoples encountered on the way, and general reflections. Specially interesting is the account of the stay in the capital of the Emperor Menelik and what is told of the personality of that sovereign. Mr.

Landor mentions incidentally that whilst he was at Addis-Abeba, the British Minister submitted to the Emperor a proposal for the establishment of a Council of State, and we note from the newspapers of last November that he has now called this Council into being. Also very interesting is the account of that unique people, the Tuaregs, to whom the author devotes a good deal of space. Mr. Landor discusses the administration of the Congo State in a spirit which would not be satisfactory to Mr. Morel. But then he holds that the African slaves are as happy people as he has seen in the world. Throughout the volumes he has many pages of particulars about the manners—or the want of them—the customs, and the physical peculiarities of the numerous tribes met with *en route*. These will probably be found unattractive to the ordinary reader, though they may appeal to the anthropologist. To some extent Mr. Landor's route covered the same ground as that of Captain Boyd Alexander, whose book was reviewed last month. But as regards the much-debated Lake Chad, of which the latter has made so close a study, Mr. Landor's information, though extensive, is confessedly a statement of the observation of French officers whom he met, and not original. We notice, by the way, that the chart of the lake in volume i. gives no scale of miles. The two books may be compared by those curious in the study of the personality of travellers.

Mr. Landor does not fear to mention various acts of foolishness on his part. On the other hand, he is to be congratulated on the address with which he extricated himself from several awkward situations.

In the latter part of his journey he saw much of French officials, and expresses unstinted admiration of their capacity and methods. A curious piece of information is that at Timbuctu one of the annual festivals is a celebration of Noah's exit from the Ark. Mr. Landor has been very successful in his photographs.

AMERICA.

Modern Argentina: The El Dorado of To-day. With Notes on Uruguay and Chile. By W. R. Koebel. London: Francis Griffiths, 1907. *Price* 12*s.* 6*d. net.*

As the author of this book remarks, it is astonishing how little literature has been published dealing with these South American States, and consequently, in proportion, there is a corresponding amount of general ignorance of their history and development prevailing. Mr. Koebel writes very enthusiastically of the Argentine, and seems to have had very exceptional facilities afforded him for gaining information. The book is not at all of the guidebook order, and although in some respects it is a trifle scrappy, it is thoroughly up to date. As implied by the title, there is no attempt at history, and only brief mention is made of the frequent revolutions which used to be the chief characteristics of these South American Republics. Argentina and the sister republics seem to have turned over a new leaf in this respect, and their continued prosperity seems assured, notwithstanding the curiously complicated nature of the population of these states.

Reise in das Moderne Mexico. By Mietze Diener. Map and 30 Illustrations. Vienna und Leipzig: A. Hartleben's Verlag, 1907. *Price* 4 *marks.*

Madame Diener, who accompanied her husband, Professor C. Diener of Vienna, on his visit to the International Geological Congress held at Mexico City in the autumn of 1906, describes in this little volume her impressions of the parts of Mexico she visited. Naturally the authoress was more interested in the people and their life and habits than in the mines and geology of the republic. The city of Mexico, the pyramids of Teotihuacan, the silver mines of Pachuca, and the

old city of Cuernavaca are noticed first. The northern districts which were afterwards visited include Guarrajuato, Saltillo, San Luis Potosi, and Tampico, and the last excursion, which was not without a mishap to part of the train, was to the new railway across the isthmus of Tehuantepec, where Sir Weetman Pearson has completed the great work of connecting the ocean between Salina Cruz and Coatzacoalcos, and establishing a trade route on Mexican soil to compete with the Panama Canal.

New Canada and the New Canadians. By Howard Angus Kennedy. Preface by Lord Strathcona. London: Horace Marshall and Son, 1907. *Price 3s. 6d. net.*

We have here an interesting and instructive addition to the rapidly increasing series of works devoted to the development of Canada. Mr. Kennedy is in evident sympathy with his subject, and has apparently spared no pains to obtain the best possible information at first hand. He points out that the country he describes, the prairie provinces of Manitoba, Saskatchewan, and Alberta, really constitute the south-west of Canada, but is coming to be known simply as the West.

In 1885, as war correspondent of the *Montreal Witness*, he accompanied the Expedition which was sent into the West to the relief of Battleford, and he describes, with vivid detail, the hardships and dangers of that campaign. He lived many years in Canada, and his knowledge of the more primitive conditions of life in the earlier days is the result of actual experience. Twenty-five years later he returned to Canada as special correspondent of the *Times*, and is again able to describe from personal knowledge the rapid and enormous strides which the country is making in all directions. He describes how, in 1811, when the Earl of Selkirk planted his little colony of Scottish Highlanders in Manitoba, "they had to come in by Hudson's Bay, and up the Nelson River. In fact, long after that time, the West was so difficult of access from the East, that a stove made in Quebec had to be shipped home to England and thence out to Hudson's Bay before it could be delivered in Manitoba." Now all this is fast changing, and while Winnipeg will soon be the centre of a railway system of great trunk railroads, a rapidly developing oversea trade both across the Atlantic to the United Kingdom and across the Pacific to Japan promises ready markets for the almost limitless produce of these new provinces. Mr. Kennedy describes the climate, the amount of land still available, and the possibilities for wheat-growing or cattle and horse ranching. He also gives a useful idea of what a man beginning to farm on his own account would spend on the implements of his trade. Those who may be thinking of going to Canada, either on business or for pleasure, cannot do better than read the book, and learn in Mr. Kennedy's own words how the quiet and steady settlement in these vast lands is steadily going on, giving, as in the case of the United States in earlier days, the possibilities of "new homes and new life, prosperity and independence, to millions of the struggling poor of Europe."

GENERAL.

Sociological Papers. Vol. III. By Several Authors. Published for the Sociological Society. London: Macmillan and Co., 1907.

This volume contains the papers read before the Sociological Society during the session 1905-6, together with reports of the discussions which followed the

reading of the papers. These are as varied in scope as in value, but for the most part have no connection with geography in the ordinary sense. That which comes nearest is Professor Geddes' address on "A suggested Plan for a Civic Museum (or Civic Exhibition) and its Associated Studies." In a community where town life predominates to such an extent as in our own, the teacher of geography cannot afford to lose any opportunity of learning how to study the city and how to interpret it to its future citizens—an aspect of *Nature Study* still too apt to be neglected. In this connection Professor Geddes's paper will be found as full of interest and suggestion as usual with this author.

Handbuch der Ozeanographie. Von Dr. Otto Krümmel, ordentlichem Professor der Geographie an der Universität in Kiel. Band I. Die räumlichen, chemischen und physikalischen Verhältnisse des Meeres. Stuttgart: Verlag von J. Engelhorn. *Price M.* 22.

This purports to be a revised edition of the first volume of Boguslawski's *Handbuch*, but as the original appeared in 1884 it is practically almost a new work, numerous scientific expeditions and soundings and investigations connected with the laying of cables and with fisheries having collected a vast amount of new material during the past twenty years. The present volume contains chapters on the dimensions of the oceans—their superficial area, depths, the configuration of their beds, etc.; on the oceanic deposits, and on the water—its salinity, specific gravity, chemical constituents, and physical properties, temperature, etc. For the discussion of these subjects Dr. Krümmel has gleaned his facts from innumerable reports, periodicals, and essays, and has produced a handbook of oceanography hitherto unsurpassed in comprehensiveness. He has also not only acted as a mere compiler, but has added calculations and expressed opinions of his own.

Of the great divisions of water Dr. Krümmel reckons only three—the Atlantic, Pacific, and Indian Oceans, making the Arctic Ocean a mere appendage of the Atlantic, and dividing the Antarctic among the three great oceans. Surely the physical conditions and fauna of the Polar oceans mark them as distinct areas, though in the case of the Antarctic there are no natural boundaries. Perhaps the estimates of the depths and volumes of the oceans are treated somewhat more fully than necessary. The accuracy obtainable increases with the number of recorded soundings, and the author's own calculations have the advantage of being based on recent data. It is not our intention to examine the work in detail at present. When the other volume is issued, a better judgment may be formed of the whole. Meanwhile it is safe to say that it is a book which all students of oceanography should read.

Statistical Abstract of the World. By Henry Gannett, LL.D. New York: John Wiley and Sons. London: Chapman and Hall, Ltd, 1907. *Price* 3*s. net.*

Dr. Gannett, of the U.S. Survey and Census, is a geographer and statistician of the highest repute, and this collection of comparative statistics, relating principally to the commerce and demography of the world, is a work of much value and interest. Its value would, however, have been greatly increased had dates been given for the various statistics, and still more so had references been given to the sources of information, making some distinction between ascertained facts and mere approximate estimates.

BOOKS RECEIVED.

We have received the following new books, which will be reviewed in due course:—

La Science Séismologique: Les Tremblements de Terre. Avec une Préface par M. Ed. Suess. Par Cte. De Montessus de Ballore. Un volume in-8° raisin (26c × 16c), 590 pages, 187 Figures et Cartes. Paris: Armand Colin, 1907. *Price* 16*fr.*

A Woman's Pleasure Trip in Somaliland. By Frances Swayne. Illustrated. Crown 8vo. Pp. xii+172. Bristol: John Wright and Co, 1907. *Price* 4*s. net.*

Circling the Globe by Sea and Land: The Record of a Personal Experience. By James Walker. Illustrated. Demy 8vo. Pp. 286. London: Henry J. Drane, 1907. *Price* 10*s.* 6*d.*

Active Service Pocket Book. By Bertrand Stewart, 2nd Lieut., West Kent (Queen's Own) Imperial Yeomanry. 3rd Edition. Pp. xxxii+940. London: William Clowes and Sons, Ltd., 1907. *Price* 4*s. net.*

Greece and the Ægean Islands. By Philip Sanford Marden. Demy 8vo. Pp. xiv+386. London: Archibald Constable and Co., Ltd., 1907. *Price* 12*s.* 6*d. net.*

Grundzüge der Pflanzenverbreitung in Chile. Von Dr. Phil. Karl Reiche. (Die Vegetation der Erde), mit 55 Figuren im Text und auf 33 Tafeln. Lex 8. Leipzig: Verlag von Wilhelm Engelmann, 1907. *Preis* 28*m.*

The Cruise of the Port Kingston. By W. Ralph Hall Caine. Med. 8vo. Pp. xxvii+351. London: Collier and Co, 1907. *Price* 10*s.* 6*d. net.*

Also the following Reports, etc.:—

The Year Book of the Scientific and Learned Societies of Great Britain and Ireland. Compiled from Official Resources. 24th Annual Issue. London: Charles Griffen and Co., 1907.

Guide to the Specimens of the Horse Family exhibited in the Department of Zoology, British Museum (Natural History). London, 1907.

Report on the Administration of Coorg for the Year 1906-1907. Mercara, 1907.

Report on the Administration of Burma for the Year 1906-1907. Rangoon, 1907.

Sudan Almanac, 1908. Pp. 68. Intelligence Office, War Office, Cairo, 1907. *Price* 1*s.*

The Official Year Book of New South Wales, 1905-6. Second Issue. By H. C. L. Anderson. Pp. 817. Sydney, 1907.

Twenty-Fifth Annual Report of the Fishery Board for Scotland for the Year 1906.

Part III. Scientific Investigations. Glasgow, 1907.

Transactions of the Inverness Scientific Society and Field Club. Vol. I., 1875-1880. Inverness, 1885.

The Early History of Stichill. By Rev. G. Gunn, M.A. Alnwick, 1901.

[*Presented by R. Richardson.*

Publishers forwarding books for review will greatly oblige by marking the **price** *in clear figures, especially in the case of foreign books.*

THE SCOTTISH GEOGRAPHICAL MAGAZINE.

ECONOMIC GEOGRAPHY.[1]

By Geo. G. Chisholm, M.A., B.Sc. (Edin.),
Lecturer in Geography in the University of Edinburgh.

(With Maps and Diagrams.[2]*)*

For the sake of clearness I had better begin with a statement of the meaning of geography as it will be understood in the present address. I define it as the branch of study which aims at estimating the value for man of terrestrial local conditions and place relations. I do not offer that as a complete definition of geography, but I think it the most convenient formula to set forth the scope of geography in its most important aspect, and that accordingly in which it has always been tacitly understood more or less clearly, and is coming to be understood more and more clearly. And if that definition be accepted, I think it will be at once seen that geography is a study that has a very close relation to economics, and through economics to history. The geographer and the economist have in fact in a large measure the same aims, though they regard them from a somewhat different point of view. According to Dr. Keynes, the differentia of economic laws is that they "imply voluntary human action." The field of inquiry in economics is usually divided into departments dealing with the production, exchange and distribution of wealth, and the production of wealth may be the production of material commodities and always depends more or less directly on such production. With reference to such production one inquiry of the

[1] An Address delivered before the Society in Edinburgh on January 29, 1908.

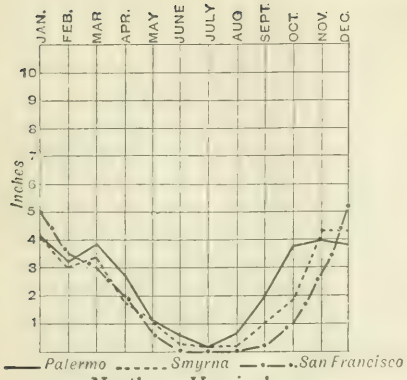
[2] The maps and diagrams accompanying this paper are taken from Mr. Geo. G. Chisholm's *Handbook of Commercial Geography*, 6th edition, and we are indebted to the publishers, Messrs. Longmans, Green and Co., for permission to reproduce them.—Ed. *S.G.M.*

economist may be, What are likely to be the principal places of production of certain commodities at any given time under the influence of the ordinary motives leading to production? The geographer puts essentially the same question, or at least one in a large measure the same in the form, What are the local advantages and place relations that favour the production of a particular commodity in one place rather than another?

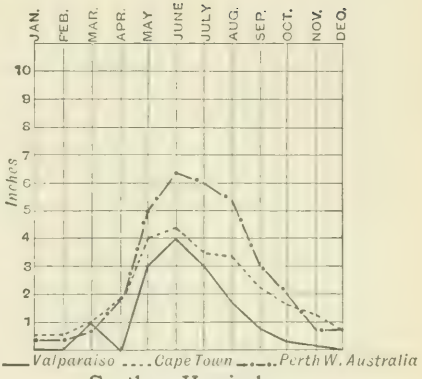
It results from the close relations between geography and economics that there is one important analogy between the two, namely, that they both of necessity take into account a large number of facts not derived from their own studies. The physical laws on which production depends are not economic laws. The economist, as we have seen, concerns himself with the general results of the ordinary motives that lead to production; still he cannot but recognise that these motives lead man to observe the actual conditions under which things are produced, and of every treatise on economics considerations of this kind form a large part. In the parallel case of geography, I will even say that the value of local conditions and place relations for man must always be estimated in the light of facts that are not geographical. If climate gets a great deal of attention in geography it is because it is taken for granted as a matter of common knowledge that the character of the climate makes in various ways a great deal of difference to man. But in geography, as in economics, many things have to be taken into account that are not matters of common knowledge, the significance of which is apt to be overlooked. The aim of the study of geography is to guard against such oversights, to beget a habit of mind (to use the phrase adopted by Lord Milner in addressing you recently on another aspect of geography) that will prevent the neglect of known facts and promote the search for unknown facts that affect the value of local conditions and place relations. It is this that makes the study of geography, like that of economics, so extremely complex, and, I will add, so important.

To indicate this importance, it may be well to give some concrete illustrations from economic geography beginning with the simpler cases and leading up to those which involve more complex considerations. These illustrations will mostly be taken in connection with production, the department of economic inquiry in which the relations between geography and economics are probably most numerous and closest.

Perhaps the simplest case that could be chosen is the production of agricultural commodities for local consumption. In this case one may say that the dominant consideration is that of climate, for there is no part of the world where some soils cannot be utilised for production provided only the climate is favourable. The special importance of this consideration may be well illustrated by some of the characteristics indicated on the accompanying diagram, on which I would direct your attention first to the rainfall typical of the Mediterranean region, the region that may be described as the cradle of our civilisation. It will be noticed that the same type of rainfall, one of dry summers and rainy winters, is characteristic of various other parts of the world both north

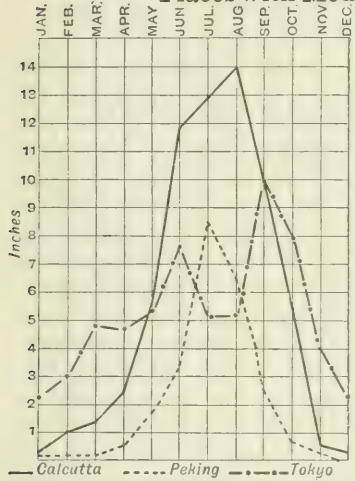


Northern Hemisphere

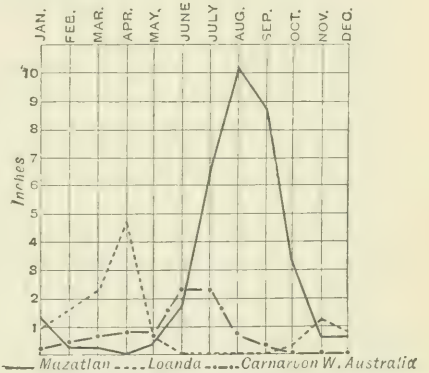


Southern Hemisphere

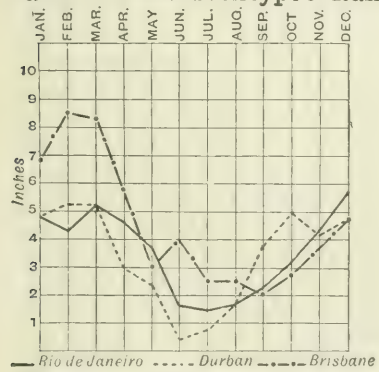
Places with Mediterranean type of Rainfall.



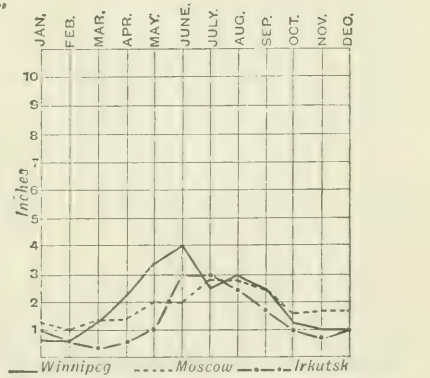
Places with Monsoon type of Rainfall.



Places in the Trade wind belt on the west side of Continents.



Places in the Trade wind belt on the east side of Continents.



Places in North Temperate zone with continental type of Rainfall.

TYPICAL RAINFALL DIAGRAMS.

and south of the equator, California, central Chili, the extreme south-west of Africa, and the extreme south-west of Australia. All of these lie more or less in corresponding latitudes and all on the west side of great land-masses, and hence might be expected to correspond fairly well also as regards temperature, as indeed they mostly do. Accordingly, it is only what might be expected when we find the same agricultural products to be peculiarly adapted to all of them.

One of the products of the Mediterranean region, wheat, is also in some of its varieties adapted to very different climates, including that of England. It is not, however, adapted to a climate with warm rainy summers, which accounts for the initial failures of two English settlements in which wheat-growing was attempted in a climate of that kind, one on the seaboard of New South Wales, and one round Port Elizabeth in South Africa.

Where crops are grown for distant markets, obviously other considerations must come into play than that of adaptability to the local climate. One of the most important factors in the economic development now going on is unquestionably the constant opening up of new wheat lands, and in most cases I think it will be admitted that the principal circumstances determining the region in which they are opened up are the extent of land with a suitable and easily worked soil and a favourable climate, with the necessary facilities for reaching the market, and with only limited opportunities for using the land for other purposes. There is abundance of land with all that is required in respect of surface, soil, and climate among other places in western North America, including Canada, in Argentina and in Siberia. They all agree too in offering only limited opportunities of using the land for other purposes than wheat-growing. In facilities for reaching oversea markets, however, the three areas in question differ very greatly. Argentina has the enormous advantage of having as its wheat collecting centres a number of seaports on the Atlantic, Buenos Aires, Rosario, Bahia Blanca, and other minor ones growing up, an advantage belonging to none of the other parts mentioned, and it is in Argentina we see the wheatfields developing most rapidly. Winnipeg, the great collecting centre for the north-west of Canada, is 400 miles from a lake-port, more than 1400 from the nearest seaport, and last autumn we had the astonishing and pregnant announcement in the papers that wheat had risen (Oct. 10th) at Winnipeg to 115 cents per bushel, equal to about thirty-eight shillings per quarter, or five or six shillings above the English *Gazette* price, a thing never before known, and one that may be looked upon as in large part due to such place relations as are above indicated. Siberia, again, is so placed that in the meantime at least it may hardly be considered as a factor in the European market.

With regard to facilities for reaching a distant market, it may be pointed out here that these must depend very greatly on the nature of the commodity, as is well illustrated by the different ratios of wheat and potato cultivation in Manitoba and England.

Wheat and potato cultivation in Manitoba and England (exclusive of Wales) :—

1907.

	THOUSANDS OF ACRES.	
	Manitoba.	England.
Wheat, . . .	2790	1537
Potatoes, . . .	32	382

Such differences are among those which have to be taken into account in explaining the more limited opportunities for utilising land in new countries than in old.

In the case of manufactured articles the seat of any given industry may be largely determined in various degrees by three important factors, the nature and amount of the labour supply, the extent of the local market, and the facilities for supply of the raw materials. The history of woollen manufactures from the middle ages downwards, and of the cotton industry in more recent times, may both be taken as good illustrations of the varying degrees in which these factors have told in determining the place of manufacture. In the thirteenth century Florence and other Italian cities were renowned for their rich woollen manufactures, even though the raw material for all the finer goods of that kind had to be drawn from distant countries, much of it from England. But then these cities had the skilled labour and a large local market for such goods—that is, Italy already possessed a large number of people rich enough to buy woollens of great price. Then the towns of Flanders, enriched by the commerce of the sea and the rivers that empty themselves into the sea opposite the south of England, developed the same industry, in which they had the great advantage of greater proximity to one great source of fine wool. Only in later centuries did England herself succeed in combining the advantages required for utilising her own wool, so that she could send fine woollens to distant shores.

In the case of the cotton industry I do not attempt now to explain how England came to take and retain such a decided lead as it has done. I have tried to do that elsewhere. All I want to point to now is the way in which abundance of local labour and a large local market, aided in two cases by local supplies of raw material, have recently promoted the rapid growth of cotton manufactures in the southern states of the Union, in India, and in Japan. It is noteworthy too that the manufactures that have grown up in all these regions are chiefly of that class that suit the local markets, and it may be regarded as a consequence thereof that in India the cotton mills, unlike many other Indian factories, are mainly in the hands of native capitalists.

It is an obvious consideration that the bulkier the material in proportion to its value, the more likely is it to be industrially treated at the place of production. It is for that reason that sugar cane, unretted flax and jute, uncleaned coco-nut fibre, and for the most part unhusked rice, cannot be exported, and why many metallic ores are partly smelted on the spot, though they are afterwards sent long distances to be refined.

It is a familiar fact that in many cases the seat of a manufacturing industry is determined by the relative cost of transporting fuel and

raw material, and it is manifest in this case that the question of the proportion of the fuel cost in the cost of the finished article must be important in deciding the most advantageous seat. Coal or other fuel generally attracts the materials of the glass and earthenware industries. For iron-smelting it is in some cases a question of the richness of the ores whether the fuel is brought to the ore or the ore to the fuel, and in some cases there is reciprocal carriage of both these bulky materials with a smelting industry at both ends. In the production of very cheap goods produced by steam-driven machinery the cost of the coal must be a more important consideration than in that of more valuable goods. It is useless to look to Aberdeen, the Tweed basin, Dumfriesshire, the west of England, or any part of Ireland for shoddy. You may find good woollens or worsteds manufactured in all these parts of the British Isles, but for shoddy you must go to Yorkshire, where coal is to be found on the spot, and where you have all the advantages of a vast organisation. But having thus instanced Yorkshire, I must guard myself against being supposed to have hinted that it is nothing but the cheap that is produced there. Far from it; I doubt if the quality of the best Yorkshire manufactures is excelled anywhere. What I have said about Yorkshire industry is no more disparaging to it than it would be disparaging to the industry of Lancashire to say that large quantities of rather costly Swiss cottons may be sold in Oldham and Bolton, but that it would be vain for Switzerland to try to compete with Lancashire (except, perhaps, on a very limited scale) in the production of cheap cottons.

In some cases the localisation of an industry is in large part determined by the degree to which labour can be replaced by machinery, plant, and organisation. At the present day I suppose it is unquestionable that Pittsburg-Allegheny is the largest iron manufacturing centre in the world. Originally that industry had peculiar advantages there in the abundance of coal and iron in the district partly on the spot, and the admirable conveniences for transport by water. Under present conditions it suffers from certain disadvantages as compared with other places in the United States, but it still maintains the priority I have indicated. Yet it is a comparatively small urban aggregate. The joint population of the two towns at last census was only about half that of Glasgow. But then what is the nature of the iron industries here concentrated? The chief products are pig-iron, rolled iron and steel, rails, and structural steel—all products, be it observed, of that class which can be turned out with little labour, (though much of that highly skilled) where plant, machinery, and organisation are all combined. It is that very circumstance that renders possible the creation that is now going on of a rival to Pittsburg in a situation in some respects more advantageous, at the new town of Gary, at the south end of Lake Michigan. From the very start this new town will be endowed with the three important requirements I have mentioned. In the case of those branches of the iron industry in which relatively large quantities of labour are required, neither Pittsburg nor the United States generally can boast of a similar success. It is said

that a steel ship costs from 50 to 60 per cent. more to build on the eastern seaboard of the United States than on the Clyde, the Tay, the Tyne, or the Laggan, and consequently it is only by prohibitive legislation that the United States can maintain a steel shipbuilding industry on its eastern seaboard at all.

I might go on multiplying such rather obvious illustrations of the dominant influence of one or two factors in localising industry, but I have, I think, already given enough to convey an idea of the variety of considerations to be taken into account in different cases. I now pass on to a somewhat less obvious consideration affecting the transport and exchange of commodities. What I refer to is the influence of the carriage of bulky goods in cheapening the carriage of the less bulky.

British External Commerce, 1907.

Imports.	1000 tons.	Mill. £.
Timber[1]	12,392	27·1
Grain and flour	10,460	75·4
Iron ore	7639	7·3
Sugar	1733	19·1
Stone	1201	1·3
Petroleum	1116	6·1
Raw cotton	1066	70·5
Iron and steel manufactures	935	7·2
Meat[2]	911	39·5
Paper-making materials	895	4·4
Raw fruit[3]	793	11·5
. . . . .		
Raw jute[4]	364	8·2
,, wool	360	35·3
Butter	211	22·5
Eggs[5]	155	7·1
Tea	141	10·8
Nitrate of soda	114	1·3
Machinery	87	5·3
Rubber	33	10·8
Silks	? 20	8·4

Exports—British.	1000 tons.	Mill. £.
Coal	66,063	42·1
Iron and steel manufactures	5166	46·7
Cotton piece goods[6]	? 1050	81·0
Cement	765	1·3
Machinery	717	31·8
Chemical manures	611	4·0
Salt	584	0·5
. . . . .		
Cotton yarns[4]	121	20·4
Linens	? 111	5·5
Woollens and worsteds	? 105	18·1
Jute goods[7]	? 100	3·7
Woollen and worsted yarns	37	8·6
Jute yarns	30	1·2
Linen yarns	7	1·2
Foreign and Colonial.		
Raw cotton	147	10·1
,, wool	140	13·4
Rice	100	1·1
. . . . .		
Rubber[4]	17	6·0

[1] Loads of 50 feet re-estimated in tons of 40 cubic feet added to tons of furniture wood as entered in the official returns.

[2] All kinds of dead meat, including bacon and hams.

[3] Non-dutiable only, and exclusive of bananas, which are entered in the official returns by bunches.

[4] The entries of commodities above the dotted lines are in order of quantity, those below the dotted lines are selected commodities.

[5] Estimated at the rate of 120 great hundreds to the ton.

[6] Exclusive of cotton hosiery, machine-made lace, etc.

[7] Including sacks.

It is, no doubt, a familiar fact that goods are generally carried most cheaply when carried in the greatest quantity. A large part of the economy referred to arises from the fact that larger ships or other vehicles may be used in the transport. But manifestly this advantage may accrue to commodities carried in comparatively small quantity if the vessels that carry them are mainly filled with bulkier goods. This gives peculiar significance to the quantity as distinguished from the value of trade whether inland or foreign, and it is unfortunate that the form in which the tables of our external trade are drawn up renders it so difficult to exhibit that trade from this point of view. One or two such attempts have, however, been made, but I have contented myself on this occasion with placing before you a partial table, partly, I confess, based on conjectural or very rough data (*see preceding page*).

You will notice in this table queries attached to the quantities of textiles exported. In the official tables the quantities of such goods are entered only in yards. After trying various methods of arriving at an estimate of the corresponding quantities in tons, I finally determined to follow a clue obtained from one of the estimates printed in the *Report of Proceedings of the Chamber of Shipping of the United Kingdom*, on the basis of calculations made by Mr. John Williamson, of Liverpool. Now, in considering the estimate thus obtained of the quantity of cotton piece goods exported, you must bear in mind that that must have some, though no exact correspondence with the raw cotton imported, and that this import of raw cotton also covers (with the same degree of approximation) the raw cotton and cotton yarns exported as well as the cotton manufactures for home consumption of cotton goods of all kinds, and also the export of all such as do not come under the general head of cotton piece goods, and all waste in manufacture. On the other hand, an allowance must be made for the weight added in sizing. What that allowance should be I do not know. Still, when all the deductions just indicated are considered, it does not seem likely that the allowance to be made on this last score can be so great as to allow us to suppose that the estimate for the quantity of cotton piece goods exported is exclusive of packing. And if packing is included both in the case of cottons and the other textiles, that is quite right, for packing ought always to be included in any estimate of the amount of shipping required for shipment. That is one reason why I adopted Mr. Williamson's method of calculation, which yields a higher result than any other method which I tried. And this was my other reason for adopting it. To enforce one of the lessons I propose to draw from the table, I prefer to have a maximum estimate for such goods, for the conclusion I draw therefrom, if sound on the basis of these figures, will be true *a fortiori* if the figures should actually be smaller. But if packing is included in these cases, and not in the others, I admit that the figures in the table are not fairly comparable with one another. Still, with all its defects, it seems to me that this table will be found very instructive by those who have never considered our commerce from this point of view before.

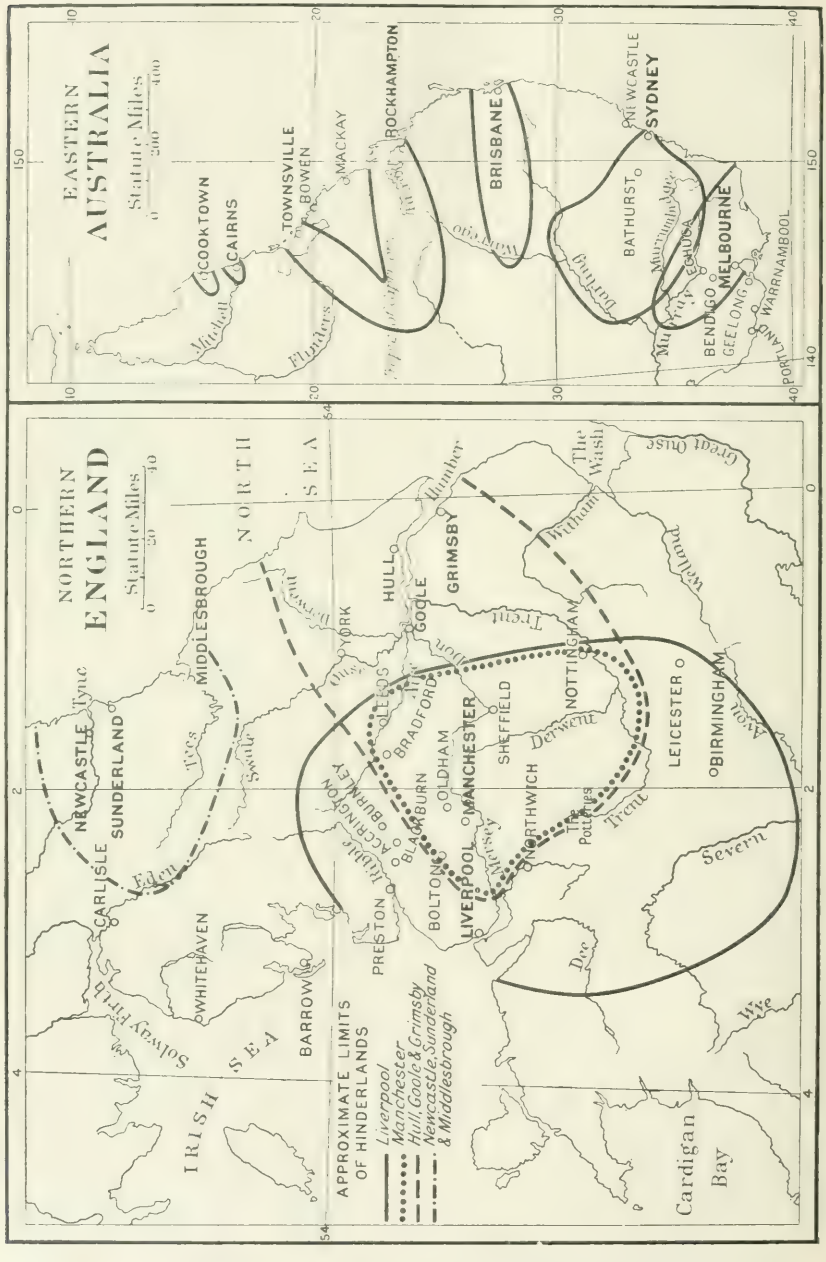
The quantity columns in it let us see the nature of the commodities that fill our big ships, the others those which make up the greater part

of the value of our commerce. The table shows how the nature of our surplus, that is, of what we have for export, and the character of our home requirements enable our big ships to carry large cargoes both outward and homeward—not generally, it is true, to and from the same ports. But when you consider that the most advantageous use that can be made of a big ship is to fill it both outwards and homewards, you will be able to appreciate how important it is for our trade that Argentina and a large part of the Pacific seaboard of North America should be deficient in coal, and that the same parts should have large quantities of bulky produce to send us in return. You will be able also to understand why it is that, though cotton goods make up so great a part of the value of our exports, no ship ever leaves Liverpool or Manchester entirely laden with cotton goods—why generally, in fact, these make up only a trifling part of the cargo; and the table likewise makes it plain that the widespread trade in bulky commodities, both out and home, of those and other ports of the United Kingdom must have an important influence in disseminating our cottons all over the world. You will also be able to realise how our important entrepôt trade, that is our exports of goods of foreign and colonial origin, is favoured by the vast trade in bulky goods based on our own requirements and surplus production, for you will observe that the bulkiest of these in the aggregate fall far below the quantities of many classes of commodities both imported and exported. That makes it easy to understand why such goods are brought chiefly to the great ports, and why in many cases it should be the most advantageous plan for foreign countries, just as for our own minor ports, there to buy at least some of what they want of those goods.

The rapid growth of the Japanese mercantile marine in recent years has attracted much attention, and one authority is said to have hazarded the prediction[1] that within twenty years Japanese shipping will have captured the whole trade of the North Pacific. When one considers that Great Britain has never succeeded in "capturing" the whole shipping even of her own seaports, one may at once dismiss the idea of any literal fulfilment of that forecast; but putting aside exaggeration in the mode of expression, I admit that there are good grounds for anticipating a continuance of the expansion which has been going on in that direction for some time past. For the conditions in Japan are wonderfully like those to which I have just been calling attention. Important fields of good coal are worked in Japan on or quite near the coast, as in our own island. Japan herself supplies a large amount of cheap yet very efficient labour for industries of all kinds. The development of her own commerce and of many of those industries is creating a rapidly growing demand for food stuffs and other bulky produce as imports. This combination exists nowhere else, and does not seem likely to arise anywhere else in the near future on the Pacific seaboard. If, therefore, the future brings about any approach to a verification of the forecast above quoted, it will not, I

[1] This statement I take from an interesting and sagacious address on the trade of Dundee during the past year by Mr. William Thomson, President of the Dundee Chamber of Commerce, as reported in the *Dundee Advertiser* of December 27, 1907; but the statement is not of a kind that makes it worth pursuing to its source.

think, be because of any military or naval success of Japan or because of the policy of political adventure on which she has now entered, but



because of the geographical facts which I have here indicated.

But while the growth of trade in the bulkier goods has cheapened

the carriage of the less bulky and more valuable, these last will bear higher transport costs than those of less value. These facts often give great complexity to trade relations, and for illustrations of that complexity I need not go as far as Japan. Abundant illustrations may be drawn from the trade of every considerable port, and above all perhaps from that of those great British ports which lie on opposite sides of the island and serve in a large measure the same regions, what I am in the habit of calling the same hinderlands. On the accompanying map, which I am permitted to reproduce through the kindness of Messrs. Longmans, Green and Co., you will see that I have indicated the hinderlands of Liverpool and Manchester as overlapping those of the Humber ports. The overlapping might indeed have been extended even further. It will readily be understood that bulky goods like Russian grain and timber may go round the island to Liverpool and Manchester, and American grain and timber similarly round the island to Hull, but that, on the other hand, much continental butter may be landed at Hull for Manchester, not impossibly even Liverpool, and that much American raw cotton imported at Liverpool is re-exported at Hull.

The same relations are even more strikingly illustrated between Glasgow and the eastern ports of Scotland, especially Leith and Grangemouth. One of the most remarkable things about the external (that is, foreign and colonial) trade of Glasgow is that Glasgow takes the lead among those British seaports at which the value of the exports exceeds that of the imports. I should mention that at the great majority of British seaports the excess is the other way, mostly very much the other way. Leith, unlike Glasgow, is one of those British ports at which the excess is very greatly on the side of imports, the value of the imports being about three times that of the exports. At Grangemouth there is also an excess value of imports, but not nearly in the same ratio as at Leith. These facts are mutually related. Nearly all the bulky and less valuable commodities required at Glasgow and in the Glasgow district come direct to Glasgow, but many of the more valuable commodities required in that district are derived from the continent of Europe and enter even for that district by the eastern ports. Hence it is that considerable quantities of butter, cheese, and eggs imported from the continent are sent on by rail to Glasgow. Grangemouth also shares in this trade, and has even a preponderant share in the trade in raw sugar imported from Hamburg and the Baltic and sent on by rail to the Greenock refineries. It is rather curious that the refined (and accordingly more valuable) sugar that comes from the continent to the same ports when destined for Glasgow is sent on by canal, the explanation being, no doubt, that the canal barges are more convenient for delivery to the Glasgow warehouses than the Greenock refineries, while the saving of transport cost is relatively more important in the case of sugar than in the case of butter, cheese, and eggs, all of which are more valuable and two of them more perishable commodities than sugar. It is to be noted too that the Glasgow deficiency in some of these commodities is largely made good by Irish produce, which does not come under the head of external trade; but to show the importance of Leith (and Grangemouth) in this branch of the Glasgow trade, I

think it is enough to mention that in 1906-7 the total quantity of Irish and all other butter imported at Glasgow was less than one-fourth of that imported at Leith (both British and foreign being included at Leith also). The much smaller excess in the value of the imports at Grangemouth than at Leith is due to the fact that Grangemouth is better situated than Leith for sending to the continent the valuable manufactures of the Glasgow district. These relations will serve, I think, to throw light on the great importance of the tobacco trade in the early growing days of Glasgow, when, so far as tobacco was concerned, Glasgow had nearly all Scotland for its hinderland.

Some other peculiarities of the trade of Leith will be understood in the light of the general considerations already set forth. Though the value of the imports at Leith is so greatly in excess of that of the exports, the quantity of the goods there exported is much greater than that imported. The reason is that Leith, like Glasgow, is a coal-exporting port. It exports it largely to the Baltic, whence large quantities of flax and hemp are obtained, and these raw materials are sent even to Dundee and other Forfarshire ports by rail. From Dundee and Dunfermline again Leith receives by rail and from Belfast by steamer large quantities of linens, some of which reappear among its exports.

Even more interesting illustrations of the complexity of trade may be derived from the trade of Dundee. The manufactures of Dundee, linens and, still more, jute piece goods, go to the most distant parts of the world with which Dundee cannot maintain direct trade relations. Leith, we have seen, is called to its aid, so also is Glasgow, and to a much greater extent London, Liverpool, and Southampton, and various circumstances favour the utilisation of these ports. The steamers that regularly ply between London and Dundee bringing to Dundee a great variety of goods, including considerable quantities of raw jute, take back Dundee manufactures, besides potatoes and other produce. Other steamers carrying jute and other manufactures from Dundee go to the Firth of Forth to take up coal for Southampton and for Tréport, near Dieppe in France, from which latter port they bring back sugar, a rather bulky cargo, as the table above given shows. Thus in both directions there is a bulky traffic to cheapen the distribution of Dundee manufactures. Liverpool steamers bring a variety of American and other produce to Dundee and take back manufactures. Steamers from Dundee to Rotterdam call at Middlesbrough for pig iron and bring back continental steel plates not only for the shipbuilding of the Tay, but also for re-export to Belfast.

Aberdeen of course exports no coal, but, on the other hand, imports many hundreds of thousands of tons. The consequence is that there is an excess of about 900,000 tons of goods carried into Aberdeen over those carried out in the trade between different ports, that is, without reckoning the fish that are merely landed at Aberdeen. It is inevitable, therefore, that the ships that call at Aberdeen must be ready to carry away cargoes at a very moderate rate. Yet one of the bulkiest of all Aberdeen exports, salted herrings, can benefit only to a limited extent through the coal trade, inasmuch as the principal market for herrings, Germany and the Baltic, is not a region which despatches

but one that receives coal. But it does benefit by another rather remarkable Aberdeen trade. Aberdeen imports large quantities of rough-hewn granite, which seems like carrying coals to Newcastle. The bulk of this granite comes from the Baltic, and this trade, as well as the imports of timber, flax and oats from the same quarter, must serve to lower the rates for the return transport of herrings. The vast trawling industry of Aberdeen does nothing for the shipping of the port, but it renders possible economic transport by rail, furnishing as it does whole train-loads of fish daily for the English Midlands and elsewhere.

These aspects of economic geography are complex enough, but still further complexity is introduced into the consideration of many geographical problems by the fact that geographical conditions are constantly changing. There is a well-known game played with 32 pieces on 64 squares. All the pieces have definite powers which may remain constant to the end of the game, yet no one can foresee all the results of a move, at least in the early stages of this game. When we deal with the field of geography we find that the pieces on the board are innumerable, their powers are exceedingly diverse, and, moreover, they do not remain constant. For more than a hundred years coal has been queen, but its powers are not relatively so great as they were a few years ago. The development by various new methods of what the French call "white coal," that is, water power, has to some extent lowered its predominance. Indirectly the introduction of internal combustion engines has also tended to encroach on the domain of coal. Both lignite and peat have proved to be excellent fuels for the production of gas required in those engines. By means of the coal-testing plant used in connection with the centennial exhibition at St. Louis, U.S.A., in 1904, it was ascertained "that a higher grade of producer gas may be obtained from lignite than can be made from bituminous or anthracite coal or coke."[1] That is, of course, not the same thing as saying that lignite is economically the best fuel for generating producer gas where anthracite or bituminous coal is available. Still the discovery must unquestionably add to the value of the enormous lignite deposits of Germany (chiefly Prussian and royal Saxony). This use is indeed one of the causes which have led to the more rapid rate of increase in the production of lignite than coal in recent years.

These are instances of changes in the relative value of local conditions in consequence of recent inventions, but striking changes may also be brought about through the development of neglected resources by methods already in use elsewhere. There is in such cases, as was pointed out by Mr. A. J. Balfour in an admirable speech which he delivered in distributing prizes at the Goldsmiths' Company's Technical and Recreative Institute on the 12th of December 1901, much leeway to make up, and that is done rapidly. An admirable illustration is afforded by the recent economic history of Germany. Some thirty or

[1] "The Production of Coal in 1904," U.S. Geological Survey, Washington, 1905, p. 180.

forty years ago the resources of that country of all kinds were very inadequately developed with reference to the standard that had been attained by industry elsewhere. The reasons for that I will not now inquire into. Bismarck is said to have expressed the belief that Germany was only in his day beginning to recover from the effects of the awful Thirty Years' War, and in that view there is probably much truth. But whatever the cause or causes, the fact was undoubtedly as I have stated, and the result was that when modern methods were applied, progress was astonishingly rapid, especially since those methods have in the meantime been undergoing constant improvement, in many cases through inventions originating in Germany. The development of Germany's manufacturing industry and external commerce within that period is well known, but I should like to direct special attention to the agricultural advance of the country in recent years, and for that reason I have drawn up the following table based upon data furnished by various issues of the *Statistisches Jahrbuch für das Deutsche Reich* :—

IMPROVEMENT IN GERMAN AGRICULTURE.

MAIN FOOD CROPS.

	1888-90.		1899-1906.	
	Average area Thous. ha.	Average yield. Kilos per ha.	Average area. Thous. ha.	Average yield. Kilos per ha.
Rye . . .	5863	990	6019	1542
Wheat . . .	1899	1320	1894	1919
Potatoes . . .	2887	8420	3257	13,109

Increase or decrease (−) in aggregate yield on average of 1899-1906 compared with 1881-90, and additional population for which the average consumption is provided :—

		Mill. Kilos.	Average consumption. Kilos per head.	Additional population in Millions.
Rye .	By improvement in production .	3236	150	21·6
	By extension of area[1] . . .	209		1·4
Wheat .	By improvement in production .	1135	90 (net)	12·5
	By diminution of area . . .	− 7		
Potatoes	By improvement in production .	13,537	600	22·5
	By extension of area[2] . . .	3880		6·5

In other branches of German agriculture similar developments have taken place.

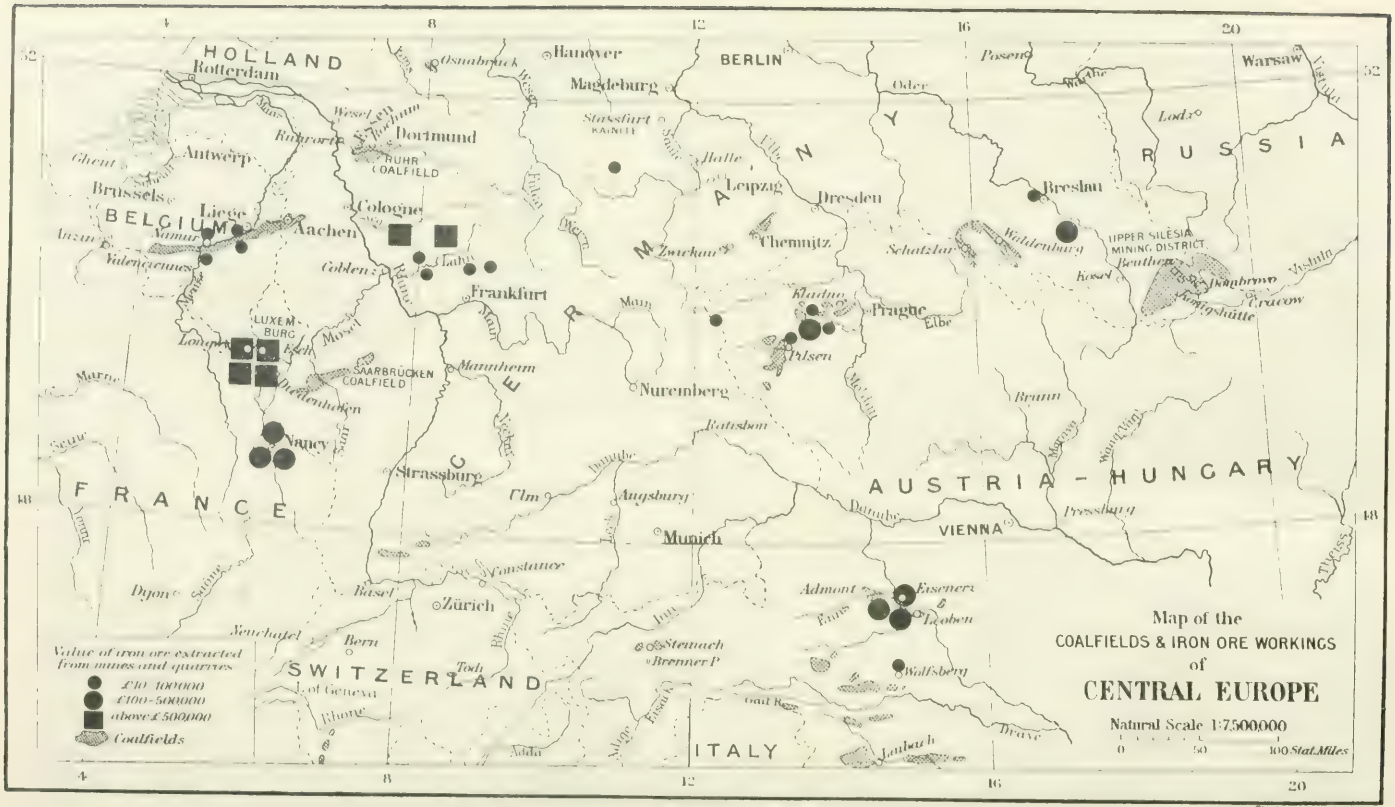
Amongst the causes of this improvement I would place first the

[1] 200 kilos per ha. allowed for seed. [2] One-fifth allowed for seed.

multiplication of the means of communication. In the early eighties of last century Germany was very inadequately supplied with railways. Since then the railway mileage has increased rapidly. That has furnished the inducement for increased production in many agricultural districts by extending and improving their market, and has at the same time facilitated the supply of agricultural implements and manures. Another important contributory cause of this advance has been the rapidly increasing use of manures—potassic, phosphoric, and nitrogenous. The potassic manures are mainly obtained from salts of which Germany has almost a monopoly, and which have for many years been produced in rapidly increasing amount in Prussian Saxony and neighbouring parts of central Germany. The phosphoric manures are mainly a by-product of the rapidly growing German iron industry. They take the form of Thomas flour, as it is called, being obtained by grinding the slag coming from the Thomas treatment of phosphoric iron ores. The nitrogenous manures are the only ones that are mainly imported. The production of such manures in the form of sulphate of ammonia is not so abundant in Germany as in our own country, but, on the other hand, Germany is the largest customer in the world for Chile saltpetre, taking about half a million tons annually, roughly one-third of the whole output. About two-fifths of this import is used to feed the sugar-beet fields.

To return to the table, it must be pointed out that the column indicating average consumption necessarily includes consumption for all purposes, including in the case of potatoes the manufacture of alcohol and starch. It is not all to be put down to the account of food. Still in the case of rye and wheat the consumption is mainly for food, and that being considered, it is obvious that the increased population thus partly provided for must have furnished a most important, I should say the chief stimulus for the parallel extension of German manufacturing industry. That makes it doubly important to consider how German agricultural production compares with that of other countries. I know of no useful comparison that can be made under the head of rye, but it seems to me that a very fair comparison may be made between the production of wheat in Germany and the United Kingdom. In both countries wheat is grown only in the situations most favourable in respect of soil, climate, and market. Now the average production indicated for the more recent of the two periods given in the table is equal to rather less than 28 bushels per acre, which is below that of the United Kingdom. It should be added that it is one thing to increase the production of wheat from 19 to 28 bushels per acre, and quite another thing to increase it from 28 to 37 bushels per acre. It is accordingly very doubtful how long this stimulus to German manufacturing industry will continue to operate as powerfully as it has done in the last twenty or thirty years.

And now after these varied illustrations of special points, what is to be said in general as to the value of economic geography? In answer to this question I would say that the advantage of cultivating the geographical habit of mind by systematic study in relation to economic



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development consists in this, that it assists greatly in appreciating the different degrees of weight that have to be attached to different geographical considerations in different cases. It may thus serve, on the one hand, as a safeguard against erroneous inferences resulting from the survey of a too narrow field, and, on the other hand, may aid us in arriving at sound anticipations of the economic development of the future, although it warns us of the greater or less degree of uncertainty attaching to all such anticipations in consequence of the extreme complexity of the influences at work and our ignorance as to the nature of the changes which new inventions or discoveries, including new methods of organisation, may bring forth.

Probably there are few departments of reasoning in which the fallacy of *post hoc ergo propter hoc*, that is, the fallacy of arguing that where one thing follows another, the thing that precedes is the cause of that which follows, is more rife than in economics, and I believe that in many cases an attentive study of geography would prove a powerful antidote to this fallacy.

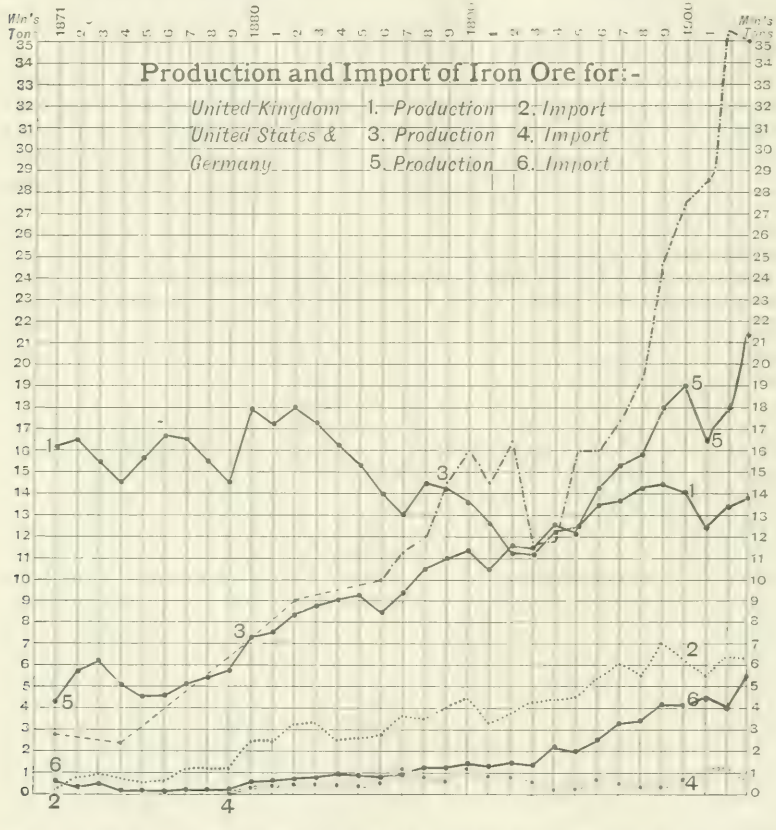
I remember two or three years ago reading in *The Times* a letter, with a signature which I do not now remember with certainty, in which it was pointed out that the rapid rise of the German iron industry dated from the year 1879, the very year of the introduction of a protective policy in that country. The implication in the mind of the writer was obvious, and indeed was explicitly stated in the letter. But while reading that letter I could not help smiling. The reason was this. I had in my possession a volume devoted expressly to the German iron industry, with special reference to the crisis of 1900 and the following years.[1] It is written by experts specially acquainted with the conditions existing in the three chief seats of that industry in the German Customs Union, that of Lorraine and Luxemburg, that of the Rhine and Westphalia, and that of Upper Silesia. Before explaining the crisis all the writers give an explanation of the previous rapid expansion of the industry. Now in this explanation not one of them mentions the protective tariff (which is rather strange, for as a contributory cause, I think it must certainly be admitted), but all with one accord lay stress on the introduction in 1879 of the Thomas process, already referred to in another connection, of treating phosphoric ores.[2] This process first made German ores available for ingot iron and steel making by wholesale methods. For the Lorraine district it had such importance that ores so poor that they had been used merely as road metal were torn up from the roads to be put into blast furnaces. A further stimulus was given to the industry by the extinction of the Thomas patent in 1894, when German ingot iron and steel produced by means of it were thereby relieved from a royalty of three shillings a ton. On the accompanying diagram the rapid expansion following both of these dates is very noticeable, and in this case a full examination of the circumstances makes it

[1] *Die Störungen im deutschen Wirtschaftsleben während der Jahre 1900 ff.* Zweiter Band. *Montan- und Eisenindustrie.* Duncker und Humblot: Leipzig, 1903.

[2] Pp. 5, 11, 13, 22, 24, 80-1, 183.

manifest that there is a causal relation between the two things, though no one, of course, would contend that the Thomas process is the sole explanation of the rapid rise there indicated.

As other examples of hasty inferences due to an imperfect examination of geographical conditions I may refer to the fact that there are some now advocating the acquisition by the State of inland waterways in this country on the ground of their success in Germany, without considering whether those waterways in Germany which are at all comparable to



those in this country or those which might be made in this country are successful at all, and others advocating on a like ground the State purchase of railways, without adverting to the fact that such success as has attended the State purchase of railways in Prussia has been due to the fact that the railways were there acquired during a period of rapid internal expansion, whereas in this country they would have to be acquired after a long period in which the development of the internal resources of the country by every available means had been pushed to the utmost and when the tendency of railway dividends was downwards rather than upwards.

If in conclusion I venture upon an illustration of the way in which the study of geography assists in the formation of sound forecasts of the future, I would do so guardedly and with a reminder of the general caution I have already entered on that head. So long, however, as we cannot see definitely how our forecasts are to be falsified, it is reasonable and indeed incumbent on us to attend to such indications of the probable future as are at our command, and there is one anticipation which seems so certain and is of such vital importance that I think a reference to it may fitly close this lecture. It is that to which Sir William Crookes drew attention in his presidential address to the British Association at Bristol in 1898, the anticipation that the new lands of the temperate regions of the globe would soon be filled up. Much has been written about the influence of sea-power on history. Not nearly enough has yet been written about the influence of bread-power on history. For the most part western Europe is the only region thought of as needing supplies from those new lands, but in a paper which I read before the geographical section of the British Association at Bradford in 1900, I expressed the view that the development of the Orient (to use the convenient term employed in North America to designate eastern Asia as distinguished from the east of North America itself and what is reached through the eastern seaboard of that continent) would make demands on the wheatfields of western North America. That forecast is being more and more fulfilled every year. I wonder how many there are here who realise the fact that one of the parts of the Dominion of Canada in which new homesteads are being most rapidly formed, the province of Alberta, is altogether out of relation to the British market as far as wheat is concerned, that it is to the Orient that it looks for its chief and most promising external market, and that it is this market which will be made more, much more accessible by the Grand Trunk Pacific Railway now in progress. If western Europe must soon have to depend for the supply of its chief food grain on different conditions from those which obtain at the present time, that cannot fail to have an enormous influence on its further economic development.

In the address above referred to, Sir William Crookes emphasised the coming necessity for enriching the wheatfields of the world by drawing on the stores of atmospheric nitrogen. But even before that steps had been taken in that direction by Professor Adolph Frank and Dr. Caro of Charlottenburg, who on the 31st of March 1895 took out their first patent for the fixation of atmospheric nitrogen and the function of cyanides and amides. More than ten years elapsed, however, before this led to any practical results. Meanwhile, in May 1905, works had been established at Notodden in Norway for the production of calcium nitrate by another, the Birkeland and Eyde process, which is a remote development of the observation of Priestley in 1785 that the formation of nitric acid accompanies an electric discharge in the atmosphere. We thus see a purely scientific observation at the end of the eighteenth century bearing fruit in the beginning of the twentieth century in such a way as to modify geographical values in Norway and elsewhere. The Frank-Caro process, however, is now being developed more rapidly. It

is based on the fact that heated carbide of calcium absorbs nitrogen from the air, producing calcium cyanamide, or what is known in commerce as nitrolim. The economic application of this process involves the production of calcium carbide at an exceptionally cheap rate, and that again involves the application of enormous water-power, generally not less than 10,000 horse-power, in situations favourable for the despatch of the bulky article that is thereby produced. The first works for carrying out the process were started at Piano d'Orta, on the Pescara in Italy, not very far from the Adriatic. Still more favourably situated works will very soon be brought into operation at the head of an arm of the Hardanger Fjord in Norway immediately adjoining the Alby works of the United Carbide Factories, Ltd., which will supply the carbide of calcium. Other works for the same purpose have been or are being started in France, Switzerland, the United States and elsewhere, and all the plants already in operation or now in course of construction for making nitrolim represent about 100,000 horse-power, capable of producing the equivalent of 200,000 tons, or from one-seventh to one-eighth of the total annual output of Chile saltpetre (nitrate of soda).

Such are some of the effects of the rapidly growing demands on the wheatfields of the world. The results of the filling up of the new lands suitable for wheat growing must, however, be very varied and complex: so complex that it is impossible to make anything like an adequate forecast of those results, but it is at least well that we should recognise in advance that a geographical survey of the world seems to indicate that a change in the present conditions of our wheat supply must certainly take place.

I had noted several other points to lay before you in this address, but I have, I am afraid, detained you too long already. I have, however, said enough to indicate the great importance of my present subject and the need for its comprehensive study. But I cannot sit down without expressing my thanks to those who have aided me in procuring for me some of the information I required. First I would express my thanks to the Secretary of the Society, Major Lachlan Forbes, who put me in communication with Mr. James Currie, of the Leith, Hull, and Hamburg Steam Packet Company, from whom I obtained much interesting information as to the trade of Leith. I am also indebted to Mr. John Leith of Aberdeen, and the harbourmaster of Aberdeen, for information as to the trade of that port, and to Mr. Crosbie Turner and Mr. David Wylie, the honorary local secretaries of the Society at Glasgow and Dundee respectively, for information as to the trade of their districts. And lastly, I have to express my thanks to Professor Adolph Frank of Charlottenburg for his kind and full reply to my specific inquiries, as well as for furnishing me with a number of papers relating to the industry which he, in conjunction with Dr. Caro and his son, Dr. Albert Frank, has been the means of creating.

THE GEOGRAPHICAL DISTRIBUTION OF LABOUR.

By H. Crawford Angus.

In the progress and development of nations there is no factor which is of greater importance than that of unskilled or raw labour—the human bone and sinew of the world, and the nation which can bring to the carrying out of its plans of progress a plentiful, cheap, and at the same time suitable supply of human energy, must assuredly outstrip in the race of progress the inhabitants of a country where the supply of labour is irregular, unsuitable, and dear. For engineers and statesmen will plan and scheme to little purpose if the means of executing their plans are not available, and it is more than probable that many of the world's greatest undertakings for the benefit of the human race have been of necessity abandoned by their promoters for the simple reason that the means of executing their designs have been impossible to obtain. If the secret history of nations is ever at some future date divulged to the world at large, it will be a surprise to the student of history to find how many serious conflicts have been brought about, how many disastrous battles-royal between the nations have originated, in a deficiency or a plethora of human labour. If the result of the French Revolution had been an increase of industrial and engineering undertakings, and if the demand for raw labour to carry out such undertakings had been of a sufficiently exigent nature to attract the manhood of the French nation, it is extremely doubtful if it would ever have been wasted on the battle-field. For the Napoleonic wars were not so much the result of the ambitious designs of a single man as the outcome of a state of national impoverishment and widespread distress among the French people, which threw a large amount of labour out of employment and effectually deterred any one from engaging in undertakings requiring manual labour, during the state of affairs which supervened after the Reign of Terror. Something had to be done to keep the people occupied and divert their minds from their misery. In fact, in only too many cases it has been the unemployment of the masses which has been the determining factor in driving nations to engage in war. A nation occupied is a nation at peace within itself and with its neighbours, while on the other hand a nation of unemployed will always be a danger to the peace of the world. Therefore in judging of the progress made, and in prophesying the future advance of nations, it is essential to keep in mind the very important factor of the quantity and quality of the raw labour which each individual nation is able to bring to the execution of its designs of progress, for without taking this special factor into account it is impossible to estimate correctly the comparative march of national power.

In most civilised countries it may be assumed that of those able and willing to direct and control the energies of others there is more than sufficient number, but it is doubtful if the number of those willing to be controlled will ever even approximately meet the demand, and as the standard of living and culture rises, and men are no longer willing or

content to devote their lives to the hewing of wood and the drawing of water, this state of things will become even more striking than it is at the present day. Labour-saving machinery, and all the devices that the ingenuity of the inventor can proffer to save the expenditure of flesh and blood, though they may for a time relieve the demand, will never really diminish the increasing need for human labour. We have only to review the gigantic schemes with which the nations are engaged to recognise that this must be so. As new schemes arise and new plans for progress are put in movement, and as new nations, at present dormant, arise to take their places in the ranks of progress, the stringency of the labour supply of the world will become more and more acute. Improved means of transit will at first relieve the situation, as with quick and cheap means of communication it will be possible to transport labourers from the places where their labour is not required to other places where it is in demand. Already a commencement has been made in this direction, and the present generation has seen Canada transporting labourers from Europe to gather her harvest of wheat, and America supplying the demands of the Panama Canal by drawing on the resources of Southern Europe, while in the recent dock strike at Hamburg, British stevedores filled the places of the strikers. It is therefore no flight of fancy to foretell the time when, instead of the labourer selecting one particular place of domicile, and there living in poverty or luxury according to the demand there is for his services, within the limited radius of the district where he resides, he will move about the world as freely as does the modern tourist, proceeding from the completion of one undertaking in one portion of the globe to the commencement of another in some other region. Labour in fact will throughout the world circulate as freely as does the gold currency of the present age, and just as, to relieve the stringency of the money market in America during the late financial crisis, England and the continent of Europe poured large sums into the American Treasury, so future years will see labour difficulties in one portion of the globe relieved by an influx of labourers from some other country. Labour transports, carrying labourers at a cheap rate to the places where they are required, will be as common on the high seas as are the passenger liners at the present day. Every country will have its "Department of Labour," where all information concerning the labour markets of the world will be carefully supplied and kept up to date, and labour exchanges, dealing in labour as now men deal in stocks and shares, will be as necessary to future generations as commercial and Stock Exchanges are to the present age.

What effect such free interchanges of labour will have upon the customs of individual nations it will be hard to prophesy. Upon their relations to one another, there can be no doubt whatever, an important effect will be produced. For with an accurate knowledge and appreciation of each other freely permeating among the masses, as is bound to happen when large numbers of labourers from different countries congregate in fellowship together, many misunderstandings and national antipathies will be removed. Is it not possible that, even as the erection of the Tower of Babel was said to be the origin of the lingual differences

of the world and of human disruption, so may some great engineering feat see the fusion of the nations into one great brotherhood of labour?

It is impossible to attempt even to deal with such a subject as the one under consideration within the limits of a magazine article in any but the most perfunctory manner, and I shall therefore just briefly touch upon the points where Geography has the most important bearing upon my subject.

Probably upon no subject has geography a more important bearing than on that under discussion, and it is to the geographer and the anthropologist that future generations of governments must look to aid them in the selection and control of their labour supplies. For to the student of labour there are a hundred considerations to be taken into account that would not occur to the ordinary man. For not only does the question of the direct cost, regularity and capacity of the labour engaged affect the execution of an undertaking, but there has also to be taken into account the health, suitability, vital force, discipline, racial peculiarities of each individual labourer, or of each race from which the labourers are recruited. There are many other questions, such as the question of food-stuffs, physique, which have to be taken into account as well as economic questions, such as whether the labourers employed are likely to spend their wages in the country where they are for the time needed, or whether they are likely to send them out of the country to their families; all these are points which cannot be overlooked in the selection of labourers to carry out schemes of national progress, and upon all of them geography has much important bearing.

A glance at the map of the world is necessary to distinguish those portions of the globe where the suitable labour supply is already fully utilised, from those where retrogressive principles of government or a backward state of civilisation leave large numbers of able-bodied men unemployed for a portion of the year; or, in other words, to distinguish between the countries in which the labour supply is already inadequate to the demand from those in which there is still an unutilised supply of labour.

Let us deal first with the aboriginal inhabitants of the various countries in order to see what their original reserves of labour are. The world can for this purpose be dealt with under two headings, viz. those where, so far as we know, there was a large indigenous population, and those in which the inhabitants were originally meagre and widely scattered. Under the first heading can be placed all the European countries with the exception of the northern portion of European Russia, the entire continent of Africa with the exception of the north-central portion comprising desert lands, and the southernmost portion comprising Cape Colony and German West Africa, which were but sparsely populated, Turkey in Asia and Syria, Japan, Persia, India and the southern portion of Asiatic Russia, the whole of China and the Malay States. Burma and Siam, Afghanistan. Under the other heading come Australia with a very meagre aboriginal population, the northern steppes of China, Siberia, the whole continent of North America and the greater part of South America, where, with the exception of a few powerful tribes,

the country was uninhabited. There was originally therefore a rather greater area of uninhabited than of inhabited lands, but, on the other hand, the population of India and China was very dense.

Eventually in process of time those countries which were sparsely populated began to attract to their shores people from the countries where overcrowding had already commenced, or oppression had driven the population to emigrate to escape from the burden of government. Thus began that filling-up process whereby the empty lands were populated, and in every case except that of Africa, the sparse aboriginal population suffered and diminished by contact with the new-comers, instead of increasing and gaining new strength and vitality. It is noticeable that the emigrants were mostly tillers of the soil, and that very few recruits were obtained from nomadic pastoral people.

So the stream of emigration continued to flow, and vast waste spaces on the earth's surface were populated by a mixed race springing from emigrants of all nations, and still the stream of emigration continues. Still the demand for labour is made by the new countries on the old, and while the children of an ancient race leave the lands of their birth to rise in the scale of civilisation while supplying the needs of a new-born people, the countries from which they originally came still lie dormant beneath the heel of oppression or the fatal lethargy which consumes more than one race. Thus it will be seen that Australia, America, Canada, and some parts of Africa are at present the greatest consumers of raw labour, either in the shape of emigrants which they absorb into their constitution, or as temporary labourers in their public works. None of these countries can cope unaided with the demand for labour which their schemes of progression require they should supply. Consequently they cannot be regarded as centres from which labour can be obtained for needs other than their own.

Africa, it is true, has a large indigenous population to draw upon, but unfortunately the class of labourers is not that best suited to the needs of a new and aspiring nation. It is mostly agricultural and pastoral, and not suited to heavy labour: climatic conditions also are a serious obstacle in transporting labourers from one place to another when they are required. But I will deal with this subject later, and turn at present to the other labour-producing and labour-consuming countries. Britain, France and Germany are all more or less labour-consumers, though in a less degree than the countries I have already mentioned, but their own labour at present suffices for their wants, and in some years they are able from their surplus to supply the needs of other countries. This will not, however, long be so if the birth-rate decreases and the schemes of public works and private enterprise progress as they should. They can therefore be disregarded as labour-producers or consumers for the purpose of this article. Spain, Portugal, Italy and Austria are producers of labour rather than consumers—that is, they usually have a large surplus of unemployed labour. But as the years go by they will no longer remain in this state. As they prosper and advance, new enterprises will engage the energies of those who at present are free to supply the needs of other lands, and thus these Northern sources of supply will

be closed. We are therefore forced to turn to other countries where national poverty or excessive despotism, or a low standard of private and public life, keep the country from engaging in schemes of progress that would absorb the indigenous supply of labour. Among countries of this class, where no immediate progress or enlightenment threatens to cut off the flow of labour to other lands, must be counted Russia, China, Northern India, Persia, Syria, Afghanistan, the Balkan States, Bokhara, Northern and Central Africa, and portions of South America. But of these countries the state of savagery in Northern India and Afghanistan renders them valueless, and it is very problematic if the number of recruits which they supply is worthy of any notice. Russia, China, Persia and Syria, the Balkan States, Bokhara, Northern and Central Africa are thus left over, and in them we have the chief sources of supply at the present day — countries where large supplies of indigenous unutilised labour lie unutilised from political troubles or want of modern enterprise. How long they will remain in this state is a doubtful question. Already China is said to be planning to take her place in the ranks of civilisation, though her teeming millions will still be available for many years. Russia, even if she be in the throes of a new birth, will be a long time before she can make use of the enormous stores of human strength and energy which exist in her at the present day. Persia and Syria will for many generations contribute their quota to the general need, and the Balkan States and Bokhara show no immediate signs of settling down to develop their own resources. In Northern Africa enormous quantities of able-bodied humanity will be available when a state of peace supervenes on the present general hostility, and so it is with Central Africa and the equatorial provinces.

It will be seen from the foregoing survey that it is especially the work of the geographer to define those lands to which national employers can look to supply their needs, and no better nor more useful work could be done by any Government than to employ geographers for this purpose. The question of the restrictions which some nations think it necessary to impose upon imported labour and emigration, is one in regard to which there is so much political divergence that I shall not deal with it here, beyond pointing out that, however necessary it is for a new country to consider the question of future generations and the result of an admixture of foreign blood, yet a good labourer will generally prove a good citizen. But here again is felt the need for the geographer and the anthropologist, for it is upon such questions that they are qualified to speak. In comparing the relative value of the various nationalities which are or may be at the disposal of the labour-consuming nations, the geographer is again most necessary, and between the geographer and the anthropologist a nation should find but little difficulty in securing the best available labour-supply. Not only must the immediate need be considered, but also the effect of the influx of foreigners, many of whom will doubtless in course of time become citizens of the State that employs them, upon the existing population. Before going further, it will be well to enumerate briefly the considerations which it is necessary for a labour-consuming country to bear in

mind in determining from what source to supply its needs. Undoubtedly health is the chief consideration, as a heavy death-rate among labourers means dear transport and dear labour. The labourer must therefore be drawn from a country of the same climatic conditions as the one he is going to, or else must be inured to changes of climate and temperature. The susceptibility of the subject to European diseases (if he has been drawn from an Asiatic source) must also be considered.

The question of cost will have to be reckoned in conjunction with the physical health of the labourer, his capacity for work, and the number of years for which his labour will be available.

The regularity of the supply is also another feature that must be taken into account, as a stoppage of supply would mean a disorganisation of work and heavy and increased cost. It will therefore be necessary to avoid recruiting among races who will be likely to return home at certain seasons of the year.

Discipline is another important consideration, as disorder means dislocation of work, and refractory workmen mean increased cost of administration.

The political aspect has also to be taken into account, namely, the effect of the influx of foreign labour upon the existing population. The consideration of the labourer as a customer who will withdraw large sums of money from circulation; the consideration of food-supply, whether it will be possible to provide for the labourer's needs from the resources of the country, or whether it will be necessary to import his food; both these require to be taken into account. To sum up, the labourer should be healthy, of good physique, not susceptible to change of climate, orderly, intelligent, easy to feed, and a good workman, producing the greatest possible amount of labour.

We may begin with Africa as a source of labour, and one which will become more productive every year now that the wastage caused by war and the slave-trade has ceased. The indigenous inhabitants then may be divided into three classes—first, the agricultural people; secondly, the pastoral, who are generally warlike; and thirdly, the nomadic, also generally warlike. The first class may be said to live by the cultivation of the soil, hunting, and fishing. They are by far the most numerous class, but as they live generally in the low-lying countries, they have not much stamina, and are very susceptible to climatic changes.

The pastoral class are of better physique than that just mentioned, but the members are not accustomed to heavy manual labour, nor are they easily controlled or amenable to discipline, for they come of a fighting stock. Meat also is a very necessary part of their diet, as they depend largely upon their herds and flocks and the game that they kill. They also succumb quickly to European diseases, but are not so liable to be affected by a change in the climatic conditions as are the members of the agricultural class.

The nomadic pastoral class affords the finest types of humanity, but all labour is distasteful to them, and they raise but little grain, living mostly on milk and meat.

On the whole, it may be said that, although Africa apparently presents

an extensive field for recruiting labour, yet it cannot, at any rate at present, rank as a labour-producing country, and this for several reasons. First, the supply is very irregular, varying with the seasons for tilling and garnering the native crops; and secondly, the death-rate among labourers taken from their own district is too high to make the experiment an economic success. Thirdly, the labourer, instead of spending his gains where he has earned them, takes them home to hoard, or to buy cattle and horses with. Fourthly, the standard of vital force or energy—labour-producing—is on the whole low, so that work done by an African workman compares unfavourably as a rule with that done by natives of other lands. Further, Africa for some time will need all her own labour; indeed she herself, if she progresses, must supplement her irregular and low-standard labour by importation from other countries.

I turn next to India, which presents a very favourable field, especially in the Punjab districts, where the population are of good physique and accustomed to manual labour. Unfortunately, race prejudice and caste distinctions are a considerable obstacle to successful recruiting, and the question of food is another consideration, for in most European countries much of it would have to be imported. On the whole, however, the inhabitants of India do not come up to the standard of labour in other countries, and the labourers are easily affected by changes of climate, and succumb quickly to disease. On the other hand, they are orderly, intelligent, and the supply would be cheap and regular.

Probably the best of all sources of labour will be ultimately found to be China, and Southern and Asiatic Russia, though the Central Asiatic States, Bokhara, and other districts will provide a very large class of physically fine, peaceful workers; and the Balkan States, Syria, and parts of Asia Minor will supply a semi-European working-class, which will be of the emigrant type—the type which will settle in the country of adoption rather than return home when their work is completed.

If we consider first of all the case of China, we may note that it will certainly be many years before China can utilise her own resources of labour, and even then there will be a margin over to supply the needs of other lands. The day is certain to come when so acute will become the state of nations of less prolific people burdened with huge enterprises for which they cannot themselves find the necessary labour, that race prejudice will be thrown aside and China will be called to aid in developing the resources of these countries. There are many points in favour of the Chinaman as a labourer. He is docile, easily controlled, as a rule free from tribal animosities, hardy, and able to tolerate wide ranges of temperature. But above all he represents the higher standard of physical energy, and the number of hours that he can labour is beyond that of inhabitants of other parts of the globe. He is also easy to feed, and though thrifty, he spends freely of his earnings in the land in which he is resident. Though he has many customs abhorrent to European ideas, and his moral tone is low, yet some of the prejudices against him will disappear as the need for his services becomes greater.

The chief point against him is that he retains his national customs and his love for his country, and does not acclimatise well in the sense of adopting European ideas and manners. He strictly maintains his own national ideas, and thus remains a foreign element in the polyglot race of his employers.

Russia and the Balkan States and the Western Asiatic States are probably the territories to which labour consumers will turn more readily than to the teeming East as represented by China and India. For the fact that the former countries are as a whole populated by a European or semi-European people will influence the employer very largely in his choice. Unfortunately, with the exception of Russia, the other countries round are inhabited by a people too warlike in their disposition to become useful labourers, and too accustomed to insecurity of life to permit of their engaging in strenuous work. In physique they are above the average, but indolence and thriftlessness will take a long time to eradicate, and during that period their work will fall far below the standard of what it should be. Of European countries, in the case of which race prejudice fortunately does not enter into the question of suitability, Russia, especially Southern and Asiatic and semi-Asiatic Russia, must be given the foremost place, on the following grounds :— The type of labourer is physically far above the average. He is constitutionally strong and healthy, and is of that stamp and figure peculiarly suited to physical labour requiring endurance and muscular strength. The labourers are easily fed and housed, and as long as they are removed from the temptation to drink they are docile and easily controlled. The want of intelligence is certainly a drawback, for they are not an intelligent race, but they are accustomed to live and toil under hard conditions. They can labour beyond the ordinary span allotted to man to labour in.

The conclusion to be drawn from the foregoing survey is, briefly, that of European sources of labour supply Russia is probably the most suitable, and of Asiatic and other sources inhabited by coloured people China is the most suitable, and if we eliminate race prejudice from the lines of consideration affecting our choice, China is a preferable source of supply to Russia.

But enough has been said to prove that the work of the geographer in relation to the world's supply of labour is of the first importance. Without definite details and statistics it is impossible to come to a perfectly accurate conclusion, and my facts and deductions have been based largely on my own observations and those of travellers and others. But certainly in no department is geographical knowledge more needed, and surely no knowledge is more necessary to a nation than accurate information concerning the sources of labour which are open to its needs. Without that knowledge public money must be wasted, much valuable time spent, and probably a large quantity of useless and cumbersome humanity introduced into the social arena. Just let us consider what terrible social troubles America would have been saved to-day, and what awful fratricidal strife would have been averted, if before she embarked in the trade in human flesh with Africa,

and introduced the negro question into her social policy, she had availed herself of skilled geographical knowledge to advise her from where she could most suitably obtain the labour which was necessary to her progress. If she had done so, or had even given the subject the thought it required, there would have been no negro question in the States. Surely that one example is enough to show the need of the geographer's skill in assisting nations to satisfy their demands for labour. Let us hope that the days of such folly are past, and that at no distant date we shall see the nations, instead of blindly tolerating a heterogeneous influx of labour and emigrants, good, bad, and indifferent, from all portions of the globe, will rely on the existence of the geographer and anthropologist to provide them with the labourers most fitted for the class of work for which they are required, and most suitable for their individual climatic conditions and social laws.

COUNT DE LESDAIN'S TRAVELS ACROSS ASIA.

By C. E. D. Black.

(*With Map.*)

In one of his graphic disquisitions on the progress of geographical discovery in Central Asia, the late Sir Henry Yule compared the shrinkage of the Unknown on our maps to the rapid evaporation of the cloud with which the breath has tinged a plate of polished steel. Thirty-one years have elapsed since the erudite editor of *Marco Polo* penned those words, but though since then expeditions from nearly every country of Europe have traversed the older continent from north, south, east, and west, it is a striking proof of the magnitude and difficulty of the task of discovery and reconnaissance that large areas in Asia should even now exist unmapped to tempt the adventurous explorer.

It was this that induced the Count de Lesdain to undertake, in company with his wife, the extraordinary journey which he accomplished in 1904-5. From Peking to Sining, Ansichow, Tsaidam, Gyantse and Sikkim—these are the sections into which the whole route is naturally divisible, and here and there the travellers are crossing the tracks of others. But, as regards the route in its entirety, the Count and his Countess have had but few predecessors. Grueber and Dorville appear to have been the first to cover the line from Peking to India in 1661-62. The whole journey took them two hundred and fourteen days from Peking to Agra. And some sixty-five years later Samuel Van de Putte, a native of Flushing, not only made his way successfully from India to Lhasa, and thence by way of Northern Tibet to Peking, but came back by the same route to India some years later, and was an eye-witness of the sack of Delhi by Nadir Shah in 1737. Unfortunately Grueber appears to have been unable or unwilling to place on record his full experiences, while Van de Putte caused his papers to be burnt, through fear that an improper use might be made of them.

Count de Lesdain's own countrymen, MM. Huc and Gabet, have a stronger claim on the gratitude of posterity, for the *Souvenirs d'un Voyage dans la Tartarie, le Thibet, et la Chine, pendant* 1844-46, penned by the former, is one of those journals of travel that can never die. And indeed there is much in the Count's narrative that reminds one of the clever and vivacious touches of the Abbé. But Huc and his colleague did not proceed further south than Lhasa, and were compelled to return by the easterly route to Macao, whereas the Count and Countess, having encountered most amazing difficulties, crossed the Eastern Himalayas and made good their way from the China Sea to the Bay of Bengal.

Such an undertaking necessitated the abandonment of all luxuries. At the outset, from Peking, the Count says in his narrative in the *Calcutta Review*:—

> We had decided to live on the resources of the countries that we proposed to pass through, and a few bottles of champagne for the due celebration of great events were almost the whole stock of our provisions. In Chinese travel, moreover, one can always obtain beef, mutton, chickens, an occasional duck, eggs, flour, and a sufficient supply of vegetables. The main point is to have a good cook.

Instead of making for Kalgan, as most western-bound travellers do, the Count turned off to the left and passed through Chai-ko-pu, a place prosperous through the plentiful opium cultivation by which it is surrounded.

> On all sides there are to be seen fields of poppies of varied colour, richly tinted, pure mauve and deep red, white and cream-coloured. The irrigation of these fields, encircled by trees, has been devised with great practical skill. The population, perfectly orderly, consists of about five thousand souls.

One cannot help wondering what the future of many of these Chinese towns will be, if and when the principal means of their support is taken from them through Government prohibition of the drug. And yet as to the mischief and extraordinary prevalence of its use there can be no question. The soldiers forming the travellers' escort were armed with ferocious-looking knives, but one of these, drawn from its sheath, proved to have only a wooden blade, the warrior explaining quite shamelessly that he had sold the steel to buy opium with.

Ortanho, one of the towns on the route to the Ordos country, which was the objective of the caravan, was a retreat for brigands during the Boxer rising a few years ago, and had scarcely changed its character since. Curses and shouts of "Yang-qui-tye" (="foreign devils") were showered upon the Europeans, and in the inn a hostile demonstration was prepared, but the sudden production of the Count's revolver caused a precipitate flight of the whole crowd. This, however, proved to be the only occasion on which definite hostility was shown. It is worth noting, however, that even in this remote part of Shansi a regiment of Chinese soldiers was being drilled by a Chinese officer who had received lessons in military movements from the Germans at Tientsin, and the drill was admirably performed. Count de Lesdain does not hesitate to predict a

very different result from the last in the next war in which Europeans may be pitted against Chinese. The victories of the Japanese over the Russians are known far and wide, and as the Chinese draw no distinction between a Russian, a Frenchman, or an Englishman, the defeat of one nation entails a loss of prestige on all, while in the matter of weapons of precision great improvements are discernible.

Ordos appears to be a sort of Mongol heptarchy, and on the chief of these princes the Count called and was hospitably treated. In 1898 M. Bonin, when travelling in the same country, had been warned by the chief's predecessor that the Boxer revolt was on the eve of breaking out, the exact date of the attack on the Peking legations being, as it turned out, correctly foretold. Bonin duly forwarded the information to his minister at the capital, but unfortunately the warning was quite unheeded, with the results that are too well known.

One of the Count de Lesdain's most interesting researches was the visit paid to the burial-place of the great mediæval conqueror, Chingiz Khan. This was not the first or second occasion on which Europeans had succeeded in baffling the Mongol endeavours to turn travellers aside from the spot. Bonin in 1898 and his predecessors, Messrs. de Vos and Verlinden, two Belgian missionaries, had, in 1875, reconnoitred and described the double white felt tents which form the tomb sheltering the ashes of the great Khan and the relics supposed to have been his personal belongings. These comprise his saddle-bow, the remains of his war-horse, a species of fire-arm, and other objects held in special veneration. Every year a grand festival is held on the spot, and amongst the functions and celebrations is one of curious import.

It seems that one of Chingiz Khan's servants incurred his special resentment. His offence consisted in having stolen a golden post or pole stuck in the ground in front of the imperial tent to which the Khan's horse was tethered. He was accordingly punished by being buried up to the shoulders and condemned to act the part of a living post. The remembrance of this penance is even now kept alive by compelling one of the thief's reputed descendants to go through the same punishment, but the victim is only detained in durance for a limited period.

The Alashan desert in the great northern loop formed by the Yellow River had previously been visited by Prejevalsky, Rockhill, and a few others, but the Count had the satisfaction of reconnoitring a new route from the river to Wangien-fu or Fu-ma-fu, the capital of Alashan. This place is remarkable as a true city surrounded with ramparts and encompassed with populous suburbs in the middle of a desert. It serves as a mart between the Chinese and the Mongols, where the latter dispose of their pastoral products, including sheep's wool, camels' hair, horses and camels in exchange for flour, rice, cotton and other stuffs, shoes and knives, most of these at ruinous prices, for the Mongol is always bested in a bargain by the astute Chinaman.

A typical notion of the way in which the Mandarins make their living in these parts was supplied by the official at Sutran, a little town near Lanchow. He was an officer of the blue button, and was supposed to be in receipt of a fixed salary of about £48 per annum. He

MAP TO ILLUSTRATE COUNT DE LESDAIN'S JOURNEY

Bartholomew Edin.

has to support a certain number of soldiers, subordinates of all kinds, a steward, some beggars, himself and his family. He is thus, in order to subsist, compelled to resort to oppressing every one right and left.

He has in fact paid a certain price for his post and naturally wishes to recover his expenses. Furthermore, if he wishes to get on, he must save a sufficient sum during his three years' occupation to buy a higher post, which will probably cost him double what he paid for that in which he is at the moment exercising a semblance of authority. He must sell justice, make a profit out of criminals, force lawsuits upon rich merchants, allow his soldiers to rob and omit to pay his debts. In this way the Chinese Mandarins, from the highest to the lowest, are rotten to the core. To change this deplorable state of things, which is at the bottom of Chinese stagnation, prodigious efforts are needed, and a lapse of time of which those who speak of the regeneration of this huge empire have no conception.

Yet Kansu is extremely rich in mines of all sorts—coal, silver, gold, tin, zinc and copper. Unfortunately the means of communication with the outside world are very defective and primitive, and until these improve the minerals are likely to remain unproductive and unutilised.

The incidents of travel were often curious enough to provide some excitement. At one time the camels, having eaten incautiously of a poisonous plant, were affected with violent sickness and paralysis, while the horses, mules and asses, although they had partaken of the same vegetable, were unaffected by it. In the night there was a sudden alarm, and in the utter darkness a wild animal made an attack on the camp and carried off the chronometer mule. It was pronounced to be a wolf, but in the morning the footprints proved to be those of a panther, not uncommon in the neighbourhood. Further on the Count experienced a still greater danger.

As I was jogging along on muleback behind the caravan, at a height of some hundred feet above the river, admiring the snow-covered country, which was really surprisingly magnificent, an enormous eagle suddenly dashed out of the rocks and swept on extended wings close to my mule's head. The animal taking fright leaped to the edge of the abyss, and for a second I felt myself hopelessly lost. Two of its hoofs lost their hold on the path and kicked loose stones on to the ice below. But by a great effort of its steel-like muscles it recovered its hold and the incident was miraculously over, leaving us safe and sound. My nerves were so shaken by the horrible tension of those seconds that I felt I could ride no more, and preferred to walk to the end of that stage.

Lanchow, the capital of Kansu, has a population of about half a million. In spite of its commanding position and great commercial possibilities, Europeans are positively loathed. Even Mr. Splingaert, originally a Belgian, now a naturalised Chinaman, and formerly secretary to Baron von Richthofen, possessed of numerous high decorations, had been denounced in placards posted over the town just before the Count's arrival. For some years mining agents despatched by King Leopold of Belgium have been endeavouring to acquire mining concessions in this city, but their efforts seem destined to be as unfruitful as those of a German company which attempted to manufacture cloth. Had the

company succeeded, its profits would have been enormous, but it had to fight complete corruption and greed, and was obliged to close its doors in total failure.

A still more interesting city is Sining-fu, which may be described as the frontier town of Tibet and the meeting-place of the numerous and diverse races that inhabit the surrounding regions.

In the chief streets of this picturesque town, lined by shops of all kinds, may be seen Chinese from all parts of the empire, Tibetans from the north as well as from Lhasa, Mongols from Ordos to the east and Zaidam to the west, Mussulmans from Kansu and Lob Nor, aboriginals whose ancient history can scarcely be traced, half-Russianised Buriats and occasionally a Hindu, *pêle-mêle*, crowded together, the naked shoulder of a Tibetan against the blue robe of a Chinaman, they discuss for an interminable time the price of a box of European matches or of a small looking-glass. All visitors to Sining-fu seem animated chiefly by the desire to satisfy their curiosity, to amuse themselves, and to buy as much as possible at small expense.

The celebrated monastery of Kumbum, visited and extolled by various travellers, from Huc and Gabet down to Sven Hedin, was duly visited.

The true wealth of Kumbum lies in its precious collection of Buddhist sacred books which are of the highest interest to scholars. The grand lama, who happened to be proceeding to a temple near by, was crowned with a yellow hat, resembling an old Roman helmet in shape, and held in his hand a painted wooden sceptre. He was a cheerful-looking person of the well-fed type, and allowed himself to be photographed with evident pride. The Kumbum lamas have been completely civilised by the few Europeans passing through, and have even learned the value of tips.

It is pleasing to read of the attention shown to the travellers by the missionaries settled in these out-of-the-way places. At Sining Mr. Ridley of the China Inland Mission gave valuable assistance and information regarding the tribes and topography of the neighbourhood; at Lanchow the Belgian Catholic Mission has a good number of converts, while the China Inland Mission is not so fortunate. The latter, however, proved a most welcome aid in lending the services of one of its lady members who nursed the Countess through an attack of typhoid with skill and devotion. Of course, it is no new thing to learn of actions of this sort: almost all travellers bear grateful witness to the kindness of the missionaries: the wonder is how refined men and women can make up their minds to face the privations, misery and dangers of these remote and uncomfortable regions with too often the most discouraging results.

The northernmost place of any importance reached by the expedition was Ansi-chow or Ansi-fan (Ngan-si Fan), a poor town on the extreme edge of the Gobi desert. In an adjoining village a halt was called, and here stores were gradually amassed for the journey into Tibet.

We had 6000 lbs. of peas for the animals, 800 lbs. of rice, 700 lbs. of flour, 550 lbs. of millet, plenty of salt and sugar and a little vinegar and Chinese wine.

It was not much to boast about, nor could we expect much variety in our menu, but it was enough to keep us going, and I relied upon some lucky shoots to give us from time to time a good dish of meat.

Southward rise the outer spurs of the wild and savage-looking mountains forming the Tibetan system. It seems inevitable that any one travelling in such a desolate region should be mistaken for a robber, and this fate befell the Count de Lesdain. Some honest peasants who had taken advantage of a sheltered and fertile spot to pasture their herds, espied the Europeans and, covering them with their long Mongol rifles, bade them decamp. The Count's people, knowing the superiority of their own repeating rifles, rushed upon the peasants, disarmed them, and gave them a sound beating. Explanations were, however, soon forthcoming, and the two parties separated the best of friends.

The expedition was now approaching the Tsaidam plain, a very peculiar and extensive marshy plateau that buttresses the great Kuen Lun range on the north. The Prince of the Tsaidam Mongols showed the travellers considerable hospitality and kindness: a welcome prelude to the supreme discomfort that was so soon to overtake them in Tibet. He not only brought presents, chiefly of food, but when he heard that there was a European lady in the party he sent his wife and daughter with appropriate gifts. These ladies wore their hair streaming down their backs with imitation shells fixed on a piece of cloth which hung down behind, an adornment quaintly recalling the information supplied by Count de Lesdain's predecessor, the mediæval missionary Grueber, who records that at the court of the King of Tangut (which could not, I think, have been far from Tsaidam) they saw a woman born in Hami, wearing her hair like knotted cords and a girdle adorned with cockle shells.

Under the guidance of an old lama, furnished by the prince, the journey was resumed; the humorous part of the programme being supplied by the cook Hoa, who evidently modelled his procedure and equipment on those of the White Knight. The caravan drivers had amused themselves by persuading Hoa, who was a very bad rider, to mount a strong but rather vicious black pony. Hoa had consequently hooked on to his saddle all the utensils that he generally carried about with him: a teapot, tin cups, a water bottle, and flour cakes. He had scarcely mounted when all this bric-a-brac began to clatter, the pony was startled by the noise and departed at full gallop, having previously deposited his unfortunate rider in a convenient hole. For the rest of the journey Hoa's equestrian ambitions were confined to a stolid mule.

Passing by some gold mines which indicate that the deposits are of considerable richness, the party continued their way southward through the Tsaidam district, the ground gradually rising as the Tibetan plateau was approached. From time to time they met caravans of Chinese merchants, who come from Sining to buy sheepskins at a low price in exchange for bad leather shoes, sugar, and dried raisins. The perils and discomforts of this part of the route were great. Clouds of the most savage description of mosquitoes attacked men, camels, and mules, while further on the crossing of the dry salt lake which forms the centre

of the Tsaidam depression was equally trying. Mud holes 20 feet deep, covered with a thin crust calculated to deceive the unwary traveller, occurred at frequent intervals, and in other parts the salt lying edgewise like the blades of a knife cut the feet of the poor beasts to pieces. To add to the troubles, the caravan drivers began to show signs of mutiny, and to plot and prepare for flight. Fortunately the Count overheard them and boldly took the bull by the horns, threatening them with punishment if they persevered in their mad intentions.

Count Lesdain's first introduction to wild yaks took place in this region. A herd of these superb animals filed along, a grand sight, about two hundred in number, calm and majestic, sweeping the sand with their long black hair, with something both of pride and bearing. They took about half an hour to wander past, and the Count could not resist the temptation of firing on the last one, which fell at the second shot. He was an immense creature: the wild yaks, as we know from the records of previous travellers, being far larger than the domestic ones. Prejevalsky speaks of having shot one eleven feet in length. But the Count had not yet done with the yaks.

A few miles further in an absolutely exposed part of the country, we suddenly saw three enormous bulls charging towards us with all the speed of their powerful, heavy gallop. There was no sheltering ridge to be seen, and we shuddered to think of the awful havoc the yaks would work among the heavily-laden mules and camels. Our only chance was to stop the brutes as soon as they should come within easy range. So I dismounted, and as our one chance of safety shouldered my Mannlicher and rested the barrel on my wife's shoulder. To my great relief I saw the leader fall on his knees and roll heavily over. The two survivors fled with all speed from the spot.

On August 16th they fell in with a most unusual sight in this desolate land, a large caravan of 220 men, rich merchants, lamas in red and yellow robes, soldiers and yak drivers all proceeding northwards. The passage took nearly an hour, and after the Count had saluted the rear guard and the latter had disappeared behind a hillock, the desert seemed more forlorn and lonely than ever. The travellers were now in the heart of the awful frozen plateau of Tibet and approaching the huge Tangla range, which forms the water-parting between the waters of the Yang-tse-kiang and the drainage towards the Indian Ocean. They found themselves within the influence of the monsoon, which breaks three weeks later in Tibet than in India. But before reaching the great mountains they were destined to experience a terrible adventure in crossing an upper tributary (Ulan muren) of the great river.

The river was divided at this point into eight streams separated by small islands, and I hoped to give my beast a rest on each island. But I had hardly reached the middle of the first stream when my mule lost its footing and began swimming valiantly. We went down stream about 200 yards before its hoofs touched ground again. To my terror it had scarcely set foot on the first island when it sank up to the body. It was a quicksand! I realised at once that if I stayed in the saddle I was lost, and with the instinct of preservation, I threw myself off and rolled on the sandbank. I felt it give way under me, but lying on

my back and opening my fur cloak I extended myself sufficiently to prevent being sucked in. I saw my mule, poor beast, disappear inch by inch, and in less than three minutes the sand had closed again over its head. I decided to roll sideways towards the river, which was only three or four yards distant. Little by little I slid towards the water. Once there my task was simple: I cast off my fur cloak and swam. The water was so cold that I could hardly breathe or strike out, but eventually I reached the shore, whence my wife had been following my movements with the greatest anxiety.

The crossing was eventually effected by observing the course followed by a herd of wild yaks, whose instinct, dull brutes as they were, led them to the safest spot. But the travellers' troubles and miseries still seemed to pursue them. Mules and camels were carried away and drowned, one bearing 400 lbs. of rice, enormous rocks hundreds of feet high and huge seas of fathomless mud, impeded though they did not stop their progress, and one of their best drivers committed suicide.

As a consolation, from a scientific point of view, on 1st September one of the principal sources of the Yang-tse-kiang was here identified issuing from a glacier. On the same day the party emerged into what may be roughly termed the Indian side of the Tibetan watershed, but in a truly desperate condition, for their last handful of flour had been consumed.

The change from the northern to the southern watershed was first observable in a prairie of luxuriant grass at the foot of a long gentle slope, crossed here and there by rivulets. It was absolutely necessary for the Count to procure food somehow, for his famished and exhausted party, and the next day good luck brought some wild yak within range. One big beast fell to his rifle:—

I brought my news back to camp, and this put fresh life into all. The men who were dozing for want of better occupation, sprang up, and four of them went off at once with their knives to cut the yak into steaks. Others broke up our last cases, and made firewood of everything that was not absolutely necessary for our progress.

A day's rest with food was now possible; but, as the Count pathetically observes, a week or two would have been better. As the party were now approaching the great lacustrine basin, with occasional habitations, traces of life appeared more frequently. They even came upon a settlement of "black-tent" nomads, whose reputation for attacking travellers is an evil one. But both these and ten Tibetan soldiers on horseback, encountered on the following day, proved friendly, and even sold them, with all good wishes, a pound of flour for a tael, an exorbitant price, but gladly paid.

The district of Nam-tso-nak, now entered, was a welcome change from the Arctic wilderness of icy mountains left behind. A green plain stretched as far as the eye could reach, covered with flocks, horsemen, and tents, numbering sixty in all, but scattered at long intervals. Occasionally riders galloped up and followed the Europeans for some miles, with no show of hostility, only with the natural curiosity that a passing caravan excites in these big children. On reaching Lake Pu-tso

amicable converse was held with several Tibetans, who showed no surprise at the sight of a sextant and an artificial horizon. One of them said he had been present at the taking of a latitude by a European, who had been stopped by the Tibetan authorities a little to the south. From the account given, the traveller would appear to have been Dr. Sven Hedin. From this native two pounds of flour and two sheep were bought. All this part of Tibet is well populated, and though not cultivated, is fertile as regards pasturage. In the valley where Sven Hedin was arrested two soldiers came up, wearing the Tibetan head-dress, something like the pointed cap of the mediæval alchemist, and put questions to the Count, but readily allowed him to proceed as soon as they saw that he was not bound for Lhasa. Just before reaching the well-known Lake of Tengri Nor a gloom was cast over the whole party by the death, from heart disease, of Siao-Chang, and later on by the desertion and death of Hin. The former had proved a *mauvais sujet*, but the event added to the demoralisation of the caravan; the loss of the second was due to the exhaustion and utter despair of the native followers, who chose every chance of trying to give their master the slip, and simply lie down and die. On the 13th of September the lake of Tengri Nor was reached, stretching in all its magnificence before the travellers:—

> It was a noble sight. The great mountain chain, a hundred miles long and always ice-bound, rose behind the expanse of deep blue waters. The peaks were reflected in the calm transparent lake, the highest being not less than 25,000 feet high, the whole range forming a more imposing framework than that of any Swiss lake. The country on the south of the Tengri-Nor is full of life. There are large collections of tents gathered round small temples, in which lamas burn incense night and day.

The incense is the produce of a plant growing abundantly on the shores of the lake, and its sale is one of the only industries of the locality. As the party advanced towards the great Brahmaputra, the tents *en route* became larger, the people seemed more wealthy, the women's dress more ornamented, several wearing jewels. But, in one instance, they were too terrified to stop and bargain with the Count, who helped himself to what he wanted, and left a silver "shoe" on the threshold of the tent as payment.

The first important Tibet town reached was Namling, a fort which the British expedition (whose route to Lhasa lay further east) did not visit. It stands on a conical-shaped hill, a monastery of three hundred monks dominating the town proper, which is peopled by nearly a thousand inhabitants. To reach it the travellers had to cross a chain-bridge of the most rickety character conceivable. Their reception was the reverse of encouraging, for at the order of the lamas all doors were shut in their faces and supplies refused. Count de Lesdain's course of action was characteristic, but as he paid for his supplies one cannot blame him:—

> As we were very hungry, I thought it best to supply ourselves with food without heeding the veto of the lamas. I accordingly fired into a flock of sheep and killed three. A little later, as we were beginning to feast on mutton and

buttered cake, a deputation of lamas appeared offering eggs and chickens. My shots had been most efficacious.

Namling lies in a bend of the river, and for long distances up and down one can see the old Tibetan forts, very like the castles on the Rhine. We can well agree with the Count that no small skill must have been required to erect such forts on almost inaccessible rocks. From Namling to the Brahmaputra the journey was easy, for the Count bought some tame yaks and gave his three remaining mules a well-deserved rest. The great river was crossed in square boats made of yak hide stretched over a framework of wood, a dangerous sort of craft, but familiar to us from the description of previous travellers. In the evening of the day Shigatse was reached, and four days later the party was enjoying the hospitality of Captain O'Connor, our trade agent, under the folds of the British flag at Gyantse. From thence to the charming residence of Mr. Claude White, the political agent in Sikkim, the transition was easy, and the toils and dangers of these adventurous travels at an end.

THE METEOROLOGICAL RESULTS OF THE "SCOTIA" EXPEDITION: A REVIEW.[1]

NUMEROUS preliminary reports of the scientific work of the Scottish National Antarctic Expedition have already appeared, and now we have before us a handsome volume in which the results of the meteorological, magnetic and tidal investigations are given in a permanent and final form. Dr. Bruce explains in an editorial note that "Parts I., II. and III. of Volume II. are the first of the Scientific Reports of the Scottish National Antarctic Expedition to appear in book form. . . . It has been thought inadvisable to keep back this portion of Volume II. till the rest was ready, in view of the extremely important nature of Mr. Mossman's monograph on the meteorology of the *Scotia*, and because the Council of the Royal Society of Edinburgh, without questioning the merits of the paper, felt themselves, on financial and technical grounds, unable to pass that monograph through the Society's transactions, as they have done in the case of several of the biological contributions." The volume is almost entirely devoted to meteorology, as the discussions of the magnetic and tidal observations occupy but a few pages.

It is well known that the Scottish Expedition was particularly strong in meteorology. Its distinguished leader was well qualified in that branch of science, and in Mr. Mossman the expedition had a man peculiarly well

[1] *Report on the Scientific Results of the Voyage of S.Y. Scotia during the years* 1902, 1903, *and* 1904, under the leadership of William S. Bruce, LL.D., F.R.S.E. Volume II. Physics. Part I. Meteorology, by R. C. Mossman, F.R.S.E.; Part II. Magnetism, by Charles Chree, Sc.D., F.R.S., and R. C. Mossman, F.R.S.E.; Part III. Tides, by Sir George H. Darwin, K.C.B., F.R.S. Edinburgh: The Scottish Oceanographical Laboratory.

fitted to fill the arduous post of meteorological director. Not only a careful observer but an original investigator, Mossman was able not only to organise and superintend the actual making of the observations, but to discuss them in a broadminded and thorough manner. We can imagine an Antarctic expedition bringing home a set of observations of unimpeachable accuracy and thoroughness that would yield good results when placed in the hands of a competent specialist who had never been south of the Line; but it is obviously an enormous advantage when the acting meteorologist is himself supremely competent to discuss his own material.

Considerable space has already been given in these pages to various preliminary reports, and we may point out that the promptness with which these reports were given publicity in this *Magazine* was remarkable and might well earn, as it did, the commendation of the greatest of living meteorologists, Professor Hann of Vienna.[1] Thus the *Scotia* sailed from these shores in the beginning of November 1902 and reached the South Orkneys at the end of March 1903; was frozen in at Laurie Bay for seven months and returned to Buenos Aires at the end of 1903, leaving Mossman and his party behind at the South Orkneys. Various scientific reports were mailed home from the Argentine, and in March 1904 a report on the meteorological work of a complete year was published. Such an achievement was rendered possible only by working up the observations day by day, and this practice had further the great advantage that any apparent anomaly at once arrested the attention and could be inquired into whilst recent meteorological events were still fresh in the mind.

We have re-read the various preliminary reports[2]—which contained many important conclusions—and have compared them carefully with the more leisurely discussions now presented in the volume under consideration. In every case the deductions made when the material was fresh to hand seem to have stood the test of a more rigid analysis, and readers of this *Magazine* are to be congratulated on having readily accessible most valuable contributions to Antarctic Meteorology. This is not the place to discuss the exact importance of the *Scotia* results; but it is very great, and we have no hesitation in saying that this final volume will rank as a meteorological classic. It represents a fine piece of work, admirably conceived and admirably executed. One of the definite objects of the expedition was to specialise in meteorology, and the supporters are to be congratulated in the manner in which that object has been realised.

Of the general scope of the volume it is sufficient to say that it embraces in fuller detail the various matters dealt with in the interim reports. Detailed statistics are given for the voyage of the *Scotia* whilst south of 30° S., for Laurie Island, and for the Falklands, and there are four separate memoirs, of which those on the South Orkneys and the Weddell Sea are perhaps the most important. We only regret that the plan of the volume did not permit of any general description of the

[1] *Meteorologische Zeitschrift*, October 1906 (Vienna).

[2] Vol. xx. pp. 113-120, xxi. pp. 417-429, xxii. pp. 252-272.

weather experienced in the South Orkneys; but doubtless all those who place it on their bookshelves will have alongside or near it that delightful book, *The Voyage of the Scotia*.

Dr. Chree's discussion of Mr. Mossman's magnetic observations calls for no particular notice, whilst Sir George Darwin finds the tidal results normal for a place on the Southern Ocean, and writes—"These results are very valuable, as relating to the only ocean uninterrupted by land throughout the whole circumference of the globe, yet in themselves they do not seem to present any features of special interest. But they do acquire much importance when considered in connection with the very abnormal results obtained by the *Discovery*, which I hope to discuss in the volumes to be devoted to the scientific work of that expedition."

A notable volume is enriched with diagrams, maps, and numerous excellent photographs.

We cannot conclude this brief notice without reminding our readers that Mr. Mossman is now resident at Buenos Aires filling an important office in the Meteorological Service of the Argentine Republic. It is to be regretted that his own country did not afford him scope for his energy and great ability, but we grudge him least to that enlightened South American Republic which has carried on with such remarkable energy the great work of the Scottish Expedition.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Lectures in March.

Mr. L. S. Amery (Editor of the *Times* "History of the War in South Africa") will address the Society on "The Military Geography of the British Empire" in the Music Hall, Edinburgh, on the 13th March.

Professor J. W. Gregory, D.Sc., F.R.S., F.G.S., will lecture before the Glasgow and Edinburgh centres on the 11th and 26th March respectively. The subject of his address will be "A Journey around Lake Eyre, Central Australia."

The Right Hon. Sir Herbert E. Maxwell, Bart., F.R.S., LL.D., will address the Society on the "Forest Resources of the United Kingdom" in Glasgow and Edinburgh on the 18th and 19th March respectively. This address will be followed by a discussion.

The Society's Application to the Chancellor of the Exchequer.

grant from public funds.

The following are copies of letters received by the Secretary of the Royal Scottish Geographical Society, Major W. Lachlan Forbes, in regard to the application recently made to the Chancellor of the Exchequer in person for a grant in lieu of rent:

TREASURY CHAMBERS, *January* 29, 1908.

SIR,—With reference to Mr. Dodd's letter of November 25 last (18665/78) relative to an application from the Royal Scottish Geographical Society for an annual grant in aid from public funds, I am directed by the Lords Commissioners of His Majesty's Treasury to request you to inform the Secretary for Scotland that They are ready to sanction a grant of £200 per annum, to commence from the date when the Society vacate the quarters which they now occupy in the National Portrait Gallery.—I am, etc., (*signed*) G. H. MURRAY.

The Under Secretary, Scottish Office.

SCOTTISH OFFICE, WHITEHALL, S.W., *February* 6, 1908.

SIR,—With reference to your letter of November 14 last, representing that, in view of the contemplated vacation by the Royal Scottish Geographical Society of the premises which they occupy in the National Portrait Gallery building, they are desirous of receiving a grant from public funds, I am directed by the Secretary for Scotland to transmit herewith, for the information of the Society, copy of a letter from the Treasury, dated 29th ult., intimating that their Lordships are ready to sanction a grant of £200 per annum, to commence from the date when the Society vacate the quarters which they now occupy.—I am, sir, your obedient servant, (*signed*) REGINALD MACLEOD.

Major W. Lachlan Forbes, Secretary, R.S.G.S.

GEOGRAPHICAL NOTES.

EUROPE.

Scientific Observations on Russian Seas and Lakes.—M. J. M. de Schokalsky, the President of the Section of Physical Geography in the Russian Imperial Geographical Society, who has been recently made an Honorary Fellow of our Society, has sent us a considerable number of reprints of his scientific papers. Among these is a summary account of the Scientific Observations which have been made upon the oceans, inland seas, and lakes of Russia, written in conjunction with Professor P. J. Schmidt, and presented to the International Maritime Exhibition at Bordeaux last year. This paper gives not only an interesting historical sketch of the progress of the scientific investigation of Russian waters, but also a concise and valuable summary of the facts at present known in regard to the numerous lakes and seas of Russia, and as such we strongly recommend it to the notice of those interested. The account of the present state of knowledge in regard to the Caspian and Lake Baikal, to name only two cases, and of the problems which their respective faunas present, seem to us of special interest. In the case of Lake Baikal the three views of the origin of the peculiar marine fauna are put forward with perfect lucidity. The author of this section seems to incline on the whole to the view that the marine affinities of the fauna are due to convergence, determined by the depth and "oceanic" characters of the lake.

The pamphlet concludes with a chapter on the work of the existing Russian biological laboratories.

Africa.

Geological Aspects of South African Scenery.—In his anniversary address to the Geological Society of South Africa last year (*Proceedings*, 1907), Dr. George S. Corstorphine, under the above title, gave an interesting account of the structure of South Africa. He points out in the first place that the special feature of the scenery is its uniformity over vast areas, and second, its geological antiquity. Not only have the main features originated in the inconceivably distant past, but even the present land surface is of geologically great age. The last of the geological changes which have produced the present form were the deposition of the Karoo beds in a huge inland lake, and the subsequent drying up of this lake as the result of the movement of elevation which produced the true mountain systems of South Africa. It was at this latter period, which probably occurred in Jurassic times, that the beds of lava found in the Drakensberg were erupted. Subsequent submergences have only affected small parts of the coastal belt, so that South Africa has been land throughout the greater part of Secondary and Tertiary times.

The country may be regarded as falling into three zones:—the Mountain Belt, the Coastal Zone, and the Interior Plateau. The Mountain Belt is well developed in the west and south, and embraces all the ranges tending north and south on the western border of the Karoo, as well as the various ranges which run east from Hex River Pass to the vicinity of Algoa Bay. All these varied ranges have the structure of true mountain chains. In places the mountain belt reaches the coast, the Cape peninsula being an isolated part of it. To the east a considerable part of the mountain belt has been lost beneath the floor of the Indian Ocean, for in Natal the same true type of mountain scenery does not occur. The Coastal zone varies greatly in thickness, and is sometimes absent. Where present it forms a low undulating landscape, of an uninteresting type. The Interior Plateau forms by far the largest part of South Africa, and is the most varied in structure. The surface has been cut by denudation into hills and valleys, but there are no true mountains of elevation. In eastern South Africa the edge of the plateau is a conspicuous feature, especially when it forms the great escarpment of the Drakensberg, but everywhere there is a sudden drop from the High Veld to the low country. The whole of the plateau is poorly watered, typical river scenery rarely occurring.

In conclusion, Dr. Corstorphine speaks of existing processes of denudation on the plateau, and strongly condemns the practice of grass-burning, as well as appealing for an extensive policy of afforestation which would protect the surface covering from destruction by the torrential rain.

The Victoria Falls.—The British South Africa Company informs us that, on the advice of the Committee of Directors who recently visited

Rhodesia, they have decided to proceed immediately with the survey of a township on the south bank of the Zambesi in the vicinity of the Victoria Falls. A suitable site has been indicated by Sir Charles Metcalfe where such a township can be established without in any way detracting from the natural beauties of the locality.

It is expected that in the course of a few months increased and improved accommodation and facilities will be provided for visitors to this beautiful spot. The splendid reaches of the Zambesi above the Victoria Falls and the many delightful backwaters and islands will be made accessible to visitors by means of a tramway from Livingstone Station on the north bank to the boathouse above the confluence of the Maramba River.

Exploration in the Shari Basin.—Captain Lenfant has recently returned to France after his explorations in the upper basin of the Shari. The work done by the expedition is detailed in the November number of *La Géographie*. In sum the results include the survey of two great blocks of territory, one in the region of the Upper Sanga, and the other in the district between the Logone and the Bahr Sara. This last stream has been shown to be the lower part of the river known as the Wom or Wam. The Wam-Bahr Sara is the main headstream of the Shari. Further, the expedition has discovered that the Pende, one of the main headstreams of the Logone, offers the best route from Carnot to Lake Chad, and *vice versa*. A large herd of cattle has already been successfully conveyed by this route from the Chad region to the territories of the Sanga.

A Telegraph across the Sahara.—According to a note in *Questions Diplomatiques et Coloniales*, M. Etiennot, Director of the Post-office and Telegraphs in the Department of Oran, has laid before the French Government a project to complete the telegraphic installation across the Sahara. At present there is a wire between Oran and Beni-Abbes, and another between Algiers and Timmimun. These lines would be extended to Adrar, the farthest military post occupied, and 1200 kilometres from the coast. From here the line would be continued in the direction of the Niger as far as Burren, a distance of 1400 kilometres, of which 1000 would be in Algerian, and 400 in Sudanese territory. On this second branch six small forts and three military posts would be established at intervals of from 80 to 200 kilometres.

As a mehari (camel postman) can cover 100 kilometres daily, no more than forty-eight hours would be required to go from one end of these posts to any point of rupture of the line. Lastly, at Burren the line would branch off in two directions, one going to Timbuctu to serve Senegal, and the other to Say to reach Zinder and the region of the Chad. Thus all the Sudan, Dahomey, and Ivory coast would be served.

The telegraph line would be suspended on metallic poles 100 metres apart, and at least 4m. 50 above the ground, so as to allow a camel-rider to pass beneath the line. The expense is estimated at two and a half millions of francs, and the works would take eighteen months.

The charge per word for Western Africa, which varies at present from one to five francs, would be reduced to forty or fifty centimes.

General.

The Geographical Association.—The annual meeting of this Association was held on January 8 at London, Mr. Douglas Freshfield presiding. During the past year the membership has shown a steady increase, the total now being 643, while four new branches have been started. A new edition of the geographical guide to books, maps, and appliances will be published at Easter. Mr. Douglas Freshfield was re-elected president, and in the course of his address spoke on the subject of geography and the Civil Service Commissioners, and also on the question of a rational curriculum in secondary schools. Major Close followed with a paper on Map Projections, after which Mr. Dickinson of Rugby exhibited views of the Rhine Gorge specially prepared for members of the Association.

The Dublin Meeting of the British Association.—The Council of the British Association has now elected the presidents of Sections for the meeting to be held at Dublin, September 2-9 next, under the general presidency of Mr. Francis Darwin. From the published list it appears that Section E (Geography) will be presided over by Major E. H. Hills, C.M.G. We learn also that Mr. J. G. Bartholomew is to be one of the vice-presidents. Of interest also to geographers is the announcement that Professor W. M. Davis, of Harvard University, is to deliver an evening discourse on "The Lessons of the Colorado Canon."

An Old Italian Chart.—The November number of the *Bollettino della Società Geografica Italiana* contains an account of the discovery, in the Bibliotheca Federiciana of Fano in the Adriatic, of an old navigating chart, hitherto unknown to students, by Visconte Maggiolo, the Genoese cartographer. The oldest known charts by this cartographer are, one at Paris, dated 1511; and another at Parma, dated 1512, while several others of later date are extant. The present map is the only one of these which includes the whole of the then known world, and is dated 15-4. It is known that in April 1534, Maggiolo received a commission from Lorenzo Lomellino to construct such a map, and it is surmised by the author of the paper, Professor S. Crinò, that in the legend of the chart the figure 3 has disappeared, and that it is therefore the chart alluded to. It has several peculiarities. Thus the coast of America is more accurately drawn than in other works of Maggiolo's, and the coast-line of Africa and the course of the Nile are wonderfully exact.

A New Geographical Annual.—That well-known periodical, the *Revue de Géographie*, has, under the editorship of Professor Ch. Vélain, changed its form, and is now to appear in an annual volume, in place of as a monthly journal. The first annual volume, that for 1906-7, has recently reached us. The object of the change, according to the editor's preface, is first to permit of the publication *in extenso* of elaborate original geographical articles which would otherwise require

to be broken up into parts; and secondly, to allow for the production of articles on geographical subjects summarising recent progress, and giving abstracts and critical accounts of recent papers and articles on the subject. The illustrations are to be a special feature of the volume. We shall summarise under separate headings, some of the more striking of the special articles in vol. i., and it only remains here to call attention to the change of format, and to offer a hearty welcome to the new venture. No work on similar lines has hitherto been published, either in French or English, and its usefulness can hardly be overestimated. The first volume is of a very high standard of excellence.

Personal.

We regret to announce the death of the Right Hon. Lord Overtoun, who has been one of the Society's Vice-Presidents for a number of years.

Commercial Geography.

Tea Planting in Jamaica.—A recent number of the *West Indian Bulletin*, the journal of the Imperial Agricultural Department for the West Indies, contains some interesting particulars of the tea plantation which has recently been started at St. Ann, in Jamaica. Indian and Chinese tea plants were imported for the Government gardens at Cinchona as far back as 1868, and nine years later a first experiment at cultivation was made on a few acres on the Blue Mountains. The experiment was, however, not continued, and no further attempt at cultivation on a commercial scale was made before the planting of the garden at St. Ann. A beginning was made with 250 plants and a packet of seed from the Cinchona gardens, and the area under cultivation has been cautiously extended. At present the gardens cover about 150 acres, and yield a tea of good quality, which was first placed on the market in 1903.

The Coalfields of the Arctic Region.—We have alluded here more than once to the coalbeds of Spitsbergen, now worked to a slight extent. In this connection it is interesting to note an article in the *Bollettino della Società Geografica Italiana* for October, which discusses the Arctic coal beds in general. The author's conclusions are, however, unfavourable to the idea that meantime these beds are likely to acquire any commercial importance. Even the more accessible of them, like those of Spitsbergen, cannot be worked at a reasonable profit, and the difficulties of working them at all are very great.

EDUCATIONAL.

The Spelling of Place Names.—We wish to call the special attention of all those interested in Geography or Geographical Education to the following notice, which has been sent to us for publication:—

At the instance of Professor Ricchieri, of the *Accademia Scientifico-Letteraria*, Milan, the reader of a paper on this subject at the Sixth International Geographical Congress, held at London in 1895, the organising committee of the Ninth International Geographical Congress, which is to meet at Geneva between the 27th July and the 6th August this year, has placed on the list of Agenda of the Congress the following question :—

What are the principal difficulties in the way of arriving at an international agreement on the transcription and orthography of geographical names, and in what manner can they be surmounted ?

Prof. Ricchieri, believing that if this problem is to be solved at all, it can only be by slow stages and methodical procedure, proposes that all that should be aimed at in the first instance should be a preliminary agreement among a few men of different nationalities interested in this question as to the fundamental points on which it is necessary that a final agreement should, if possible, be reached, and that a statement of those points should be laid before the Congress at Geneva, which should then be asked to appoint a small committee to study and procure the discussion of those points, and ultimately to draw up proposals and resolutions thereon. He further suggests that this committee should be expected to publish its proposals at least one year before the meeting of the next International Congress, which, it is hoped, might then be in a position to draw up final resolutions on the subject. This scheme of operations has received the support of Professor Henry Cordier of the *École spéciale des langues orientales*, Paris ; Professor Robert Sieger of the University of Graz ; and of Mr. G. G. Chisholm, recognised Teacher of the University of London (Birkbeck College), who have agreed to co-operate with Prof. Ricchieri in drawing up the preliminary statement of fundamental points requiring solution to be laid before the Geneva Congress. Mr. Chisholm will be glad to forward to Prof. Ricchieri any suggestions on this question sent to him at his private address (59 Drakefield Road, Upper Tooting, London, S.W.).

Teachers should note that *The Geographical Teacher*, of which we have hitherto only received occasional copies, has now been placed upon our exchange list, and will be found in the library as it appears. A complete set of this periodical is also available for reference. As *The Geographical Teacher* is primarily educational in its appeal, and has within the few years of its existence already published a number of valuable articles, this announcement should be of great interest to our teacher associates and others interested in the teaching of geography.

In connection with the development of geographical teaching in Scotland, we are informed that during the present session a class in Commercial Geography is being held at Whitehill Public School, Dennistoun, Glasgow, in connection with the evening classes there, and twenty students have enrolled their names for this course.

NEW BOOKS.

EUROPE.

Greece and the Ægean Islands. By PHILIP S. MARDEN. London: A. Constable and Co., 1907. *Price* 12*s.* 6*d. net.*

As the United States now furnish annually the greatest number of tourists to Greece, it is not surprising to have a volume like this from an American visiting what he calls the land of the "most fascinating of all the bygone nations." After some preliminary observations, in the course of which the author says he found modern religion in Greece saturated with ancient ideals and descended from pagan originals, he describes his landing at Canea in Crete, and then his ride out to Suda Bay and his view of the warships of the jealous Great Powers watching over the destinies of this troublous half-Christian, half-Mohammedan island. Then he proceeds to Candia, locally known as "Megalo Kastrin," having like Canea Venetian fortifications and the same lack of harbourage except for small sailing craft. From Candia he drove to Cnossos, the site of the ancient palace of King Minos, four miles away, from whence were derived "relics of monarchs who lived before Troy was famous and which the English excavator Evans, who has exhumed the palace of Minos, has classified as of the 'Minoan' period," while many relics have been discovered by the American investigator Mrs. Hawes (*née* Boyd) from Cnossos, Phaestos and Gortyna, and are with the others exhibited in the Museum at Candia. "For those who reverence the great antiquities, Candia and its pre-classic suburb are distinctly worth visiting and are unique among the sights of the ancient Hellenic and pre-Hellenic world." Crossing to the Piraeus, the author drove to Athens, noting its dreary surroundings, its unpaved streets, and its cleanliness; but he does not refer to its dust. He says he had never "experienced a night before Easter in Athens," and had been told it was then "dangerous or disagreeable to be abroad in the streets"; but this is a mistake. He complains of the noisy character of its inhabitants, but seems to have been in Athens during an election when politicians everywhere become vocal. In a chapter on the Acropolis he justifies the removal of the "Elgin marbles" from the Parthenon to London with the remark "that had they not been removed as they were, they might never have been preserved at all." A description of excursions in Athens, and of Delphi, Mycenae and the Plain of Argos, Nauplia and Epidaurus, Arcadia, Andhritsaena and the Bassae Temple, Olympia, Delos, Samos and the temple at Branchidae, Cos and Cnidos, Rhodes, Thera, Nios, Paros, and Corfu complete, with excellent illustrations and a sketch map, a volume written in an entertaining but scholarly style which will be found of great use to any intending visitor to the sacred shores of Hellas.

Six Weeks and the Mediterranean. By PASSENGER. London and Liverpool: Geo. Philip and Son, 1908. *Price* 1*s. net.*

While forming an excellent advertisement for the Nord-Deutscher Lloyd line, this little book gives a useful and attractive account of a Mediterranean tour, accompanied by carefully reproduced charts and photographs. Pompeii is particularly well illustrated. The description of Athens is most perfunctory, but on such cruises this famous city has to be "done" in a few hours. Five *days* were given to Constantinople, as it was thought much more important. The author sailed from Constantinople to Alexandria *via* Smyrna in one of the fast twin-screw petroleum-burning Roumanian steamers, "the greyhounds of these seas." He thinks the

"land of Egypt" may now be called the "land of Cook," that potentate being now its Pharaoh. He ascended the Nile to Assuan, which he terms "the lodestone of Upper Egypt." The book is a wonderful shilling's-worth.

My Alpine Jubilee. By FREDERIC HARRISON. London: Smith, Elder and Co., 1908. *Price 3s. 6d. net.*

This is a pleasant little volume consisting of six letters written from Switzerland last year by Mr. Harrison, together with some reprints of articles dealing with Alpine subjects. The author is well known as a genuine lover of the Alps —of both their upper snow-clad slopes and rocky precipices and of the meadow and forest below; and many will find pleasure in his descriptions of the past and the present, of the old Switzerland and of the new.

ASIA.

Wanderings in Arabia. By CHARLES M. DOUGHTY. Arranged with Introduction by EDWARD GARNETT. London: Duckworth and Co., 1908. *Price 16s. net.*

These two volumes are an abridgment of Mr. Doughty's larger work *Arabia Deserta*, which appeared nearly twenty years ago. Mr. Doughty travelled in Northern and Central Arabia during 1877 and 1878, sometimes joining in the Haj or Sacred Pilgrimage, sometimes escorted by the nomad Beduin.

The geographical interest of the work lies in his discovery of the great volcanic Harra or upland, which under many names, and with considerable breaches, in one of which lies El Medina, stretches over nearly seven degrees of latitude—28° N. to 21° N.—from Tebuk to Mecca. This upland, in some places a succession of deep troughs (niggeras) full of blown sand, in others a labyrinth of lava crags and lava sand plains, reaches its greatest height—6000 feet—in the Harra of Khezbar, which makes the division of waters between the Wady er-Numma which, if perennial, would be a feeder of the Euphrates, and the Wady el-Humth, which takes the direction of the Red Sea. Parallel to this volcanic upland, to the eastward, is the sandstone chain of Jebel Helman and Jebel Irnân, with its outliers of Jebel Birrd and Jebel el-Karram, and beyond that again the Nefud, the desert of whiter sand, whose edge shows all along upon the brown sandstone desert "baked hard in the everlasting drought." Still further eastward is the el-Jebel, the interior highlands, and Hayil, the capital of the Emir Ibn Rashed.

As a personal record the work throws a clear light on life in the desert, where lie the circuits of the Beduin, full of old debts for blood, in which at every strange meeting all is fear, suspense of mind, and mistrust. The interest is enhanced by the fact that all through his wanderings the writer never concealed that he was a Christian.

The abridgment has been skilfully arranged so as to present to the reader a work which, though shortened, is not marred by a sense of incompleteness.

AMERICA.

The Cruise of the Port Kingston. By W. RALPH HALL CAINE. London: Collier and Co., 1908. *Price 10s. 6d. net.*

Mr. Ralph Hall Caine was one of a party who visited the West Indies as the guests of Sir Alfred Jones, K.C.M.G., on board the R.M.S. *Port Kingston*. But this most readable book which has resulted is really an account of Jamaica, not

merely of the earthquake, which occurred while the ship was in harbour there, but of the history, commerce, and in particular of the religion and social conditions of the island. The negro with his Obeahism, his Voodoo worship, and his Christianity, is a strange study.

Mr. Hall Caine has read widely on his subject and writes of it with enthusiasm. He supplies abundance of statistics, but the lessons he wishes to convey are sometimes put into the form of very effective stories which lend variety to the writing. Possibly too much space is devoted to the vexed question between the Governor and the American admiral, but that apart, the book is of permanent value. The illustrations are many and excellent.

AUSTRALASIA.

In the Land of Pearl and Gold. By Alexander Macdonald, F.R.G.S. London: Blackie and Son, Limited, 1907. *Price* 10*s.* 6*d. net.*

In our notice of Mr. Macdonald's *In Search of El Dorado*, which appeared in the January number of this *Magazine* last year, we expressed our conviction that the author had other tales to tell, and our hope that he would give them to the public. He has acted on the suggestion, and here in this new book *In the Land of Pearl and Gold* we have sixteen more tales, of which we can certainly say that they are as exciting and amusing as their predecessors and are related with the same vivacity and skill. The scene is laid in Australia or in New Guinea with the exception of the last story, which has to do with Christmas Island. The illustrations are again good.

GENERAL.

The International Geography. By Seventy Authors. Edited by Hugh Robert Mill. With 489 Illustrations. London: Macmillan and Co., Ltd., 1907. *Price* 12*s. net.*

Our readers will note that this important geographical work has been transferred from its former publishers to Messrs. Macmillan. The new title-page bears no statement as regards the number of the edition and, except for the very inobtrusive note as to the change of publishers on the reverse, there is nothing on it to suggest that the book first appeared in 1899. In the interests of exactness we cannot help regarding this as unfortunate. We do not, however, wish to suggest by this that the book has not been revised to date, for we note that even Lieut. Shackleton's expedition finds mention under *The Antarctic Regions*, though it did not reach the ice till after the close of 1907, but still the fact that some of the articles were written close upon ten years ago should, we think, have been suggested by the title-page. The facts are indeed set forth in the preface, which has been retained with minor alterations from the first edition. The merits of the book are too well known to need fresh emphasis here; so far as we have tested it the changes appear to be of a minor character, and affect especially the bibliographical lists. The price has been reduced, and certain sections are obtainable separately.

Guide to the Great Game Animals (Ungulata) in the Department of Zoology, British Museum (Nat. Hist.). Printed by order of the Trustees, 1907. *Price* 1*s.*

This illustrated guide gives a clear and simple account of the hoofed animals of the globe, and though based primarily upon the British Museum collection, it

could be used with profit by visitors to our Scottish Museum. The hoofed animals are, and have always been, of such vast importance to man as draught animals, as beasts of burden, as a great source of food, and so on, that no teacher can afford to omit all consideration of them from a course of geography; and though the guide does not profess to treat them in their geographical aspects, yet it contains much that the teacher will find useful.

History of the Incas, by Pedro Sarmiento de Gamboa, *and the Execution of the Inca Tupac Amaru*, by Captain Baltasar de Ocampo. Translated and edited by Sir Clements Markham, K.C.B. Cambridge: Printed for the Hakluyt Society, 1907.

The sixteenth century of our present era contributes to the annals of history and romance a brilliant roll of names of distinguished soldiers, sailors, explorers, and adventurers such as it would be difficult to rival since the dawn of history. England, Scotland, France, Spain, Portugal, have each added its quota to the roll of honour. The names of some of these heroes are household words, and will remain so for ever; some are lost to history, but some are destined to achieve a tardy recognition at the hands of posterity. This has been the fate of Don Pedro Sarmiento de Gamboa, a soldier, sailor, explorer, and adventurer of Spain in the days of Good Queen Bess and her famous enemy Philip II. The story of his strenuous life is typical of his century, and most typical of the extraordinary vicissitudes of fortune.

Don Pedro was born in 1532 of Galician parents and joined the military service of Spain at the age of eighteen. Having served in Europe for five years he crossed the Atlantic to serve in Mexico and Guatemala, and thence he went on to Peru. There he probably held office under the Viceroy de Nieva, who was murdered in Lima in 1564. In the same year Sarmiento fell under the suspicion of the Inquisition, and after a long trial he was found guilty of complicity in magic and sentenced to undergo penance, naked, in the Lima Cathedral, and to be banished for ever from the Indies. An appeal to the Pope, however, produced a reduction of the sentence of banishment. In 1567 he started from Callao with two ships on a voyage of discovery to the West; unfortunately for himself he refused the command of the expedition, the success of which was rendered impossible by the dissensions and incompetence of those who had charge of it. The most important result of the expedition was the discovery of the Solomon group of islands. In 1569 Sarmiento returned to Peru to find a new and more appreciative Viceroy, Don Francisco de Toledo, whose fair fame as a soldier and administrator is indelibly smirched by the stain of the judicial murder of the last of the Incas. The story of this crime is told in simple and graphic language in the second part of the volume now before us by an "honest old soldier," Captain Baltasar de Ocampo. After the perpetration of this crime the Viceroy directed Sarmiento to compile a history of the Incas, and it is the history thus prepared which has now been published by the Hakluyt Society under the able editorship of Sir Clements Markham, the veteran president of the Society, who, we may recall to our readers, translated and edited in 1895 the narratives of Sarmiento's voyages to the Straits of Magellan. From the editor's introduction we learn that Sarmiento's history was prepared for the express purpose of discrediting the Incas and of supporting the unjust claims of Spain. It was compiled from the sworn testimony of descendants of the Incas, who were brought together from all parts of the country, and required to state what they knew of its former history. The result, after compilation by Sarmiento, and

somewhat unscrupulous editing by the Viceroy, is the history now before us. The original manuscript was presented to King Philip, and after various vicissitudes of fortune found a resting-place in the library of the University of Gottingen. In 1906 a translation was published in Berlin.

Soon after the completion of the *History of the Incas*, Sarmiento again fell into the clutches of the Inquisition, was accused of complicity in necromancy, and after a long trial was condemned to banishment. The Viceroy, however, prevented the execution of the sentence, as Sarmiento's services were urgently needed for military expeditions. Two years afterwards the Inquisition for the third time prosecuted and condemned Sarmiento on an equally absurd charge, and again he owed his escape to his exceptional usefulness in the public service which induced Toledo to intervene for the second time in his behalf. A year or two afterwards Sarmiento was detailed for the difficult and wearisome task of checkmating Drake, and it was while endeavouring to circumvent and capture the great English sailor that Sarmiento went on the voyages to the Magellan Straits, his reports of which were translated by Sir Clements Markham and published by the Hakluyt Society in 1895. His next service was in connection with the fortifications and formation of settlements in the Straits. The expedition ended in disaster. In 1586 Sarmiento was captured by Sir Richard Grenville's squadron off the island of Terceira and taken to England. There he soon became the friend of "a gentleman usher of the Queen," *i.e.* Sir Walter Raleigh, who showed him much personal kindness. Sarmiento has described to us an interview of two and a half hours which he had with Queen Elizabeth, during which they conversed in Latin. Indeed the gallant sailor seems to have made many friends in England, including the Lord Treasurer, Burleigh, and the High Admiral, Lord Howard, and after a detention of only two months he was released and sent back to Spain. His misfortunes, however, were far from over, for, while on his way to Spain, he was treacherously arrested in France and thrown into prison, where he suffered great hardships. He was not released till he had suffered more than a year of confinement, cruel at any time, but naturally doubly loathsome to a sailor. There is some uncertainty as to the career of Sarmiento after his release. He may have been the Pedro Sarmiento who took part in an unsuccessful expedition against Tedore. According to the opinion of Sir Clements Markham, from whose erudite and interesting introductions much of what we have noted about Sarmiento has been taken, he ended his days as a very old man in Manila. The volume now before us is valuable, more on account of its historical than its geographical interest, but we confidently recommend it to our readers, especially if read in connection with the narratives published in 1895.

The Polarity of Matter. By Alex. Clark, M.A. London and Edinburgh: Gall and Inglis, n.d.

The author of this book explains, among much else, the origin of Terrestrial Magnetism. Since no intelligent and well-informed person now accepts in its simplicity "the hypothesis that the earth is a great magnet whose poles are the two fixed points located by Ross," the destructive criticism is valueless. Mr. Clark's theory leads no distance towards an elucidation of magnetic distribution on the earth's surface and is based on the assumption that atmospheric air has magnetic retentivity greater than iron. We recommend him, before again venturing into the fascinating field of physical speculation, to study Gauss's theory of terrestrial magnetism, and to make sure that he really understands what

Hertzian waves are. The author possesses an ingenious mind and would do good service if he also possessed an equivalent profundity of knowledge.

Whitaker's Almanack, 1908. *Price* 2*s.* 6*d.*

Whitaker's Peerage, Baronetage and Companionage for the year 1908. *Price* 5*s.* London : Whitaker, 1908.

These useful volumes have made their annual appearance, and as usual also, fresh improvements have been made with the object of adding to their value. We notice that in the case of the Almanack the present is the fortieth annual issue.

NEW MAPS.

EUROPE.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st December 1907 :—One-inch Map (third edition, engraved, with hills in brown or black).—Sheet 42 and 50. Price 1s. 6d. Third edition, printed in colours and folded in cover, or flat in sheets. *Mull*, Sheet 44 ; *Crieff*, Sheet 47. Price, on paper 1s. 6d. ; mounted on linen, 2s. ; mounted in sections, 2s. 6d. each.

Six-inch and larger Scale Maps. Six-inch Maps (revised), full sheets, heliozincographed, with contours. *Caithness.*—Sheets 13, 23, 24, 28, 29, 33, 34 ; price 2s. 6d. each. Sheets 25, 30, 39 and 43 ; price 2s. each. Full sheets, engraved, without contours. *Ross and Cromarty.*—Sheets 17, 87 ; price 2s. 6d. each. *Sutherland.*—Sheets 13, 23, 59, 96, 97 ; price 2s. 6d. each. Sheets 3, 11 ; price 2s each.

1 : 2500 Scale Maps (revised) with Houses stippled, and with Areas. Price 3s. each. *Berwickshire.*—Sheets IV. 2, 5, 6, 9, 10, 13, 14 ; IX. 4, 7, 12, 15, 16 ; X. 9, 10, 13, 14 ; XI. 9, 10 ; XIII. 7, 8, 11, 12, 14, 15, 16 ; XIV. 9, 16 ; XV. 3, 8, 9, 11, 12 ; XX. 2, 3, 4, 6, 7, 11, 12, 14, 15 ; XXI. 1, 2, 5, 6, 9, 10, 13, 14 ; XXX. 3, 4, 7, 8, 11, 12, 15, 16 ; XXXI. 9, 13. Sheets XXX. 2, (6 and 10) ; XXXI. (7 and 8), (14 and 10) ; XXXII. (4 and 3). Price 1s. 6d. each. *Haddingtonshire.*—Sheets XVII. 11, 12.

Note.—There is no coloured edition of these sheets, and the unrevised impressions are withdrawn from sale.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st January 1908 :—One-inch Map (third edition), engraved, in outline. Sheets 48, 52, 55, 61, 62. Price 1s. 6d. each.

Six-inch and larger Scale Maps. 1 : 2500 Scale Maps (Revised), with Houses stippled, and with Areas. Price 3s. each. *Berwickshire.*—Sheets I. 14, 15 ; IV. 1, 3, 7, 11, 15 ; V. 3, 10 ; X. 1, 2, 3, 5, 6, 7, 8, 11 ; XI. 5, 6, 7, 11 ; XIV. 5, 12, 13, 15 ; XV. 2, 4, 10, 13, 14, 15 ; XVI. 1, 2, 3, 5, 6, 9, 10, 11, 12, 16 ; XIX. 2, 3, 4, 7, 8, 11, 12, 15, 16 ; XX. 1, 5, 9, 13, 16 ; XXI. 3, 7, 11, 15 ; XXII. 2, 3, 5, 7, 9, 10, 13, 14 ; XXVI. 2, 3, 4, 6, 7, 8, 10, 11, 14, 15 ; XXVII. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13. Sheets I. 13 ; XIX. 6 ; XXV. 4 ; XXVI. 1 ; XXVII. (12 and 16). Price 1s. 6d. each. *Haddingtonshire.*—Sheets XII. 15, 16 ; XVII. (3 and 4).

Note.—There is no coloured edition of these Sheets, and the unrevise impressions are withdrawn from sale.

GEOLOGICAL SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st December 1907 :—Six-inch Maps. Quarter Sheets, uncoloured

price 1s. 6d. each. *Edinburghshire.*—3 NE. : 3 SE. : 12 SE. *Haddingtonshire.*—4 SW. ; 4 SE.

ISLE OF WIGHT.—Bartholomew's "One-inch to mile" Map. Coloured orographically, with inset plans of Ryde and Ventnor, accompanied by complete Pocket Guide. Price 2s. mounted on cloth.

John Bartholomew and Co., Edinburgh.

This large-scale map, with accompanying plans and text, forms a complete and detailed guide to the Isle of Wight. The contour colouring shows the surface of the island in effective relief.

AFRICA.

ABYSSINIA.—General Staff Map on Scale of 1 : 250,000, or about four miles to an inch. Provisional issue. Sheet 68-M, Harrar. 1907. Price 1s. 6d.

Topographical Section, General Staff, London.

CAPE COLONY.—General Staff Map on Scale of 1 : 250,000, or about 4 miles to an inch. Reconnaissance Series. Sheets 128 A, Warmbad ; 128 G, Little Bushmanland ; 128 L, Strydenburg. 1907. Price 2s. each sheet.

Topographical Section, General Staff, London.

GOLD COAST.—Map published by the authority of Sir John P. Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1 : 125,000 or about two miles to an inch. Sheets—72 K IV., Fumso ; 72 Q II., Prahsu. 1907. Price 2s. each sheet. - *W. and A. K. Johnston, Ltd., Edinburgh and London.*

SINAI PENINSULA.—General Staff Map on Scale of 1 : 250,000, or about 4 miles to an inch. Provisional issue. Sheets—17 D and J, El-Arish ; 17 I and C, Port Said ; 17 K and E, Rafah ; 17 L and F, Mt. Hor ; 17 O, Suez ; 17 P, Nakhl ; 17 Q, Wadi Taba ; 17 R, Akaba. 1907. Price 1s. 6d. each sheet.

Topographical Section, General Staff, London.

SOMALILAND.—General Staff Map on Scale of 1 : 250,000, or about 4 miles to an inch. Provisional issue. Sheets—68 G, Biyo Kaboba ; 68 H, Harag Tid ; 68 I, Bulhar ; 68 N, Jifa Medir ; 68 O, Adadleh. 1907. Price 1s. 6d. each sheet.

Topographical Section, General Staff, London.

WEST AFRICA.—Part of West Africa, including Gold Coast and Northern, Southern Nigeria, showing railways and telegraphs. Scale 1 : 6,336,000. 1907. *Topographical Section, General Staff, London.*

SOUTH AFRICA.—Railway Map published by the weekly journal *South Africa*. Scale about 65 miles to an inch. 1908. Price 1s.

Winchester House, London, E.C.

A clear railway sketch-map which seems to serve mainly as a medium for commercial advertisements.

ASIA.

INDIA.—Bathyorographical Map, constructed and engraved by W. and A. K. Johnston, Limited. Scale 1 : 3,000,000, or 47 miles to an inch. Wall Map, 40 × 52 inches. Price 12s., mounted on rollers and varnished.

INDIA.—Railways and Canals, Political Divisions, Density of Population, Industries. Four Maps forming Wall Map, 40 × 52 inches.

INDIA.—Forest Lands under Government Control, Agriculture, Annual Rainfall and Temperature, Minerals. Four Maps forming Wall Map, 40 × 52 inches.
W. and A. K. Johnston, Ltd., Edinburgh and London.

These three wall maps amply illustrate the physical, political, and economic geography of India. They are clearly and effectively drawn, and are admirably adapted for school use.

PERSIA AND AFGHANISTAN.—General Staff Map, coloured orographically. Scale 1 : 4,055,040 or 1 inch to 64 miles. Price 2s. 6d.
Topographical Section, General Staff, London.

As a specimen of hypsometric contour colouring this map is a very pretty piece of work. By the production of such general maps the Intelligence Department of the War Office will materially assist the scientific study of physical geography.

GENERAL.

ATLAS UNIVERSEL DE GÉOGRAPHIE.—Commencé par M. Vivien de Saint-Martin et continué par F. R. Schrader. No. 58—Afrique Australe ; Echelle de 1 : 5,000,000. No. 74—Etats-Unis d'Amérique, Feuille Nord-Est ; Echelle de 1 : 5,000,000. Price 2 francs each map.
Librairie Hachette et Cie., Paris.

ATLAS GEOGRAFICZNY.—Prof. Dr. E. Romer. 1908. Price K. 1·80.
[*Presented by the Author, Lemberg, Galicia.*

This little Polish school atlas reflects the greatest credit on its author, Dr. Romer. It is an elementary atlas, and consists of only ten plates, bathyorographical maps of the world and the continents, with special maps of Austria-Hungary and Galicia, but they are all most beautiful and highly finished specimens of cartography, deserving of special commendation.

OUTLINE MAPS.—Series of Bathyorographical outline maps, consisting of Europe, Asia, Africa, North America, South America, Australia, British Isles, England and Wales, Scotland, Ireland, France and Spain, South-East Europe, The Alps, Asia Minor and the Caucasus, The Middle East, India. Price 1d. each. *W. and A. K. Johnston, Limited, Edinburgh and London.*

POCKET ATLAS.—Prof. A. L. Hickmann's Geographical Statistic Universal Pocket Atlas. Price 5s. *Nillson and Co., London.*

This is an English edition of Prof Hickmann's Taschen-Atlas published in Vienna. The maps in the atlas call for no special notice. The pictorial diagrams are its chief feature of interest, and are successful in presenting a graphic summary of economic and demographic conditions.

BOOKS RECEIVED.

We have received the following new books, which will be reviewed in due course :—

The Coming Struggle in Eastern Asia. By B. L. Putnam Weale. Demy 8vo. Pp. xvi + 656. *Price 12s. 6d. net.* London : Macmillan and Co., 1907.

The History of the Geological Society of London. By Horace B. Woodward, F.R.S. Demy 8vo. Pp. xx + 336. London : Geological Society, 1907.

The Rhine: Its Valley and History. By H. J. Mackinder. With Illustrations in colour after Mrs. James Jardine, and Maps. Large fcap. 4to. Pp. viii + 226. *Price* 20*s. net.* London: Chatto and Windus, 1908.

New Zealand Revisited: Recollections of the Days of my Youth. By the Right Hon. Sir John Eldon Gorst. Demy 8vo. Pp. xii + 336. *Price* 12*s.* 6*d. net.* London: Sir Isaac Pitman and Sons, Ltd., 1908.

The History of Babylonia and Assyria. By Hugo Winckler, Ph.D. Translated and edited by James Alexander Craig, Ph.D. Revised by the Author. Demy 8vo. Pp. xii + 352. *Price* 6*s.* London: Hodder and Stoughton, 1908.

My Life in the Open. By Will H. Ogilvie. Crown 8vo. Pp. xii + 303. *Price* 5*s. net.* London: T. Fisher Unwin, 1908.

La Rivalité Anglo-Russe au XIX^e^ Siècle en Asie. Par le Dr. Rouire. Un volume in-18 jésus. Pp. viii + 298. *Price* 3 *fr.* 50 *c.* Paris: Armand Colin, 1908.

Earthquakes: An Introduction to Seismic Geology. By William Herbert Hobbs, Professor of Geology, University of Michigan. Illustrated. Crown 8vo. Pp. xxxi + 336. *Price* 8*s. net.* London: Sidney Appleton, 1908.

The Moon: A Popular Treatise. By Garrett P. Serviss. Illustrated. Crown 8vo. Pp. xii + 248. *Price* 6*s. net.* London: Sidney Appleton, 1908.

The International Geography. By Seventy Authors. Edited by Hugh Robert Mill, D.Sc., LL.D., F.R.S.E. With 489 Illustrations. Demy 8vo. Pp. xx + 1088. *Price* 12*s. net.* London: Macmillan and Co., 1907.

Wanderings in Arabia. By Charles M. Doughty. Being an abridgment of *Travels in Arabia Deserta*, arranged with Introduction by Edward Garnett. In two volumes.' Vol. I. Pp. xx + 309; Vol. II., pp. x + 297. *Price* 16*s. net.* London: Duckworth and Co., 1908.

Six Weeks and the Mediterranean. By Passenger. With Illustrations and Charts. Pp. 186. *Price* 1*s.* London: George Philip and Son, 1907.

My Alpine Jubilee, 1851-1907. By Frederic Harrison. Crown 8vo. Pp. viii + 141. *Price* 3*s.* 6*d. net.* London: Smith, Elder and Co., 1907.

Cape Colony To-Day. By A. R. E. Burton, F.R.G.S. 4to. Pp. viii + 315. Cape Town: Cape Government Railway Department, 1907.

Die Entwicklung der Kontinente und Ihrer Lebewelt. Ein Beitrag zur Vergleichenden Erdgeschichte. Von Dr. Theodor Arldt. Pp. xx + 730. *Preis* 20 *m.* Leipzig: Wilhelm Engelmann, 1907.

Archhelenis und Archinotis. Gesammelte Beiträge zur Geschichte der Neotropischen Region. Von Hermann von Ihering. Pp. iv + 350. *Preis* 6 *m.* Leipzig: Wilhelm Engelmann, 1907.

Egyptian Self-Taught (*Arabic*). By Captain C. A. Thimm. Third Edition. Revised and enlarged by Major R. A. Marriott, D.S.O. Pp. 80. *Price* 2*s.* 6*d.* (*cloth*). London: E. Marlborough, 1907.

Also the following Reports, etc. :—

Whitaker's Almanack for the Year 1908. By Joseph Whitaker, F.S.A. Crown 8vo. Pp. 1082. *Price* 2*s.* 6*d.*

Whitaker's Peerage, Baronetage, Knightage, and Companionage for the Year 1908. Crown 8vo. Pp. 836. *Price* 5*s.* London: Whitaker and Co., 1907.

Report on the Administration of Coorg for the Year 1906-1907. Mercara, 1907.

Publishers forwarding books for review will greatly oblige by marking the price *in clear figures, especially in the case of foreign books.*

THE SCOTTISH

GEOGRAPHICAL

MAGAZINE.

THE CLIMATE OF THE BRITISH ISLES.[1]

By ANDREW WATT, M.A. (Edin.), F.R.S.E.,
Secretary to the Scottish Meteorological Society.

(*With Maps and Diagrams, including a Rainfall Map by* Dr. H. R. MILL.)

WHITE of Selborne held that "the weather of a district is undoubtedly part of its natural history," and certainly it is true that no account of the geography of a country is complete without some description of its climate, that is, of its average weather. In the case of the British Isles, we should talk, perhaps, rather of their climates than of their climate, for though their area is small it embraces a remarkable variety of climatic conditions.

SOME GENERAL CONSIDERATIONS.

We are apt to complain of our climate, and perhaps it is not an ideal one, but we forget how far north our little islands lie, and that John o' Groats is less than six hundred miles from the Arctic Circle. The truth is that we share with the north-western fringe of Europe generally quite exceptional climatic conditions, and that, whatever the drawbacks of our climate in other respects, we enjoy more favourable temperature conditions than any other lands within the same latitudes. Temperature extremes of a country are not determined merely by distance from the equator: the geographical parallels of latitude are "light" lines and not "heat" lines. Compare, for example, the enormous temperature range that prevails in Southern Siberia with the moderate variations under which we live. Lake Baikal—in the latitude of England—is

[1] An abstract of an Address delivered before the Society at Edinburgh on February 19, 1908.

frozen over for three or four months every winter, yet during the hot short summer the country round it yields a magnificent wheat crop which ripens with almost magic rapidity. There could be no more striking contrast than that shown in our diagram (Fig. 1) between the temperature variations at Edinburgh throughout the year and those at Irkutsk, yet these places are in the same latitude. So, too, in further Asia, Vladivostock—an ice-bound port in winter—is farther south than the Channel Islands.

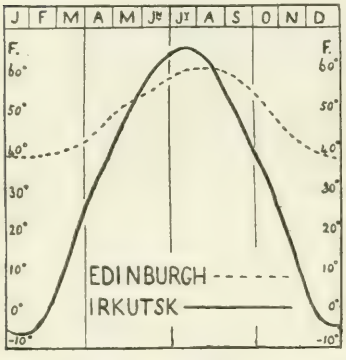


FIG. 1.—Mean Monthly Temperatures at Edinburgh and Irkutsk.

Such a contrast as that between Edinburgh and Irkutsk is the contrast between the "marine" and the "continental" types of climate, the former with a moderate, the latter with a large range of temperature. Everywhere, at least in the temperate zones, as we pass from the coast to the interior of great land areas, we find the one type passing into the other. The following table, reproduced from Hann's *Climatology*, shows the transition as we pass from the south-west of Ireland eastwards along the parallel of 52° N. to Central Siberia:—

MEAN TEMPERATURES ALONG LATITUDE 52° N. FROM WEST TO EAST.

Station.	N. Lat.	Longitude.	Jan.	July.	Difference.
			F.	F.	F.
Valencia . .	51°54′	10°25′ W	42·3°	59·2°	16·9°
Oxford . .	51°46′	1°16′ W	38·5°	61·2°	22·7°
Münster . .	51°58′	7°38′ E	34·3°	63·1°	28·8°
Posen . .	52°25′	17° 5′ E	27·1°	64·9°	37·8°
Warsaw . .	52°13′	21° 2′ E	24·3°	65·7°	41·4°
Kursk . .	51°45′	36° 8′ E	15·1°	67·6°	52·5°
Orenburg . .	51°46′	55° 7′ E	4·5°	70·9°	66·4°
Barnaul and Semipalatinsk .	51°52′	80°30′ E	−0·4°	71·2°	71·6°

Thus, as we pass eastwards from the Atlantic border of Europe, we find the summers growing steadily warmer and the winters rapidly colder, so that in Southern Siberia the temperature difference between January and July is more than four times as great as it is at Valencia in the south-west of Ireland.

The great contrast between the temperature variations of a continental climate and those of a marine climate, is due to the different behaviour of land and water towards the heat rays of the sun. Land stores up heat rapidly and loses it rapidly, whilst water stores up heat slowly and parts with it slowly. Thus everywhere the sea has an

ameliorating influence on climate, and even great inland lakes make the winters milder and the summers cooler over the land near their shores. Further, several causes have combined to give the waters of the North Atlantic Ocean, on the edge of which our islands lie, a remarkably high temperature, not merely on the surface but down to a very considerable depth.

But the mere fact that our islands are in contact with the great heat reservoir of the North Atlantic is far from fully explaining the comparatively small temperature variations characteristic of our climate, variations that seem entirely abnormal to our high latitudes. For, imagine our islands transferred across the Atlantic and set down close to the north-eastern shores of Quebec and the coast of Labrador. We should then be still within the same latitudes, but under what different conditions should we live:—our rivers in winter no longer open to all the commerce of the world, but ice-bound like the St. Lawrence. Indeed, the contrast between the climatic conditions of the eastern and western shores of the Atlantic is one of the most remarkable things in the physical geography of the globe. Once more we lay Hann's masterly treatise under contribution, and in the following table compare the temperature conditions of places, pair by pair, in the same latitude but on opposite sides of the Atlantic:—

TEMPERATURES ON THE EASTERN AND WESTERN COASTS OF THE NORTH ATLANTIC OCEAN.

Station.	Latitude.	Coldest Month.	Warmest Month.	Difference.
		F.	F.	F.
Nain (Labrador)	57°2′	−3·8°	51·1°	54·9°
Aberdeen (Scotland)	57°2′	37·2°	57·7°	20·5°
St. John's (Newfoundland)	47°6′	22·5°	59·5°	37·0°
Brest (France)	48°4′	43·9°	64·8°	20·9°
Halifax (Nova Scotia)	44°7′	22·6°	64·4°	41·8°
Bordeaux (France)	44°8′	42·4°	69·1°	26·7°
New York	40°8′	28·9°	75·6°	46·7°
Naples	40°8′	48·2°	77·2°	29·0°
Norfolk (Virginia)	36°8′	40·3°	78·6°	38·3°
San Fernando (Spain)	36°5′	52·7°	76·1°	23·4°

Thus Nain, the Moravian Mission Station in Labrador, is exactly in the same latitude as Aberdeen, yet the mean temperature of its coldest month is below zero Fahrenheit and no less than forty-one degrees below that of Aberdeen. The extremes are less striking as we go from north to south. An exactly similar contrast, though perhaps a less extreme one, exists between the opposite shores of the North Pacific Ocean.

What, then, is it that gives to the eastern shores of the North Atlantic temperature conditions so much more favourable than those of the Western? The answer is simple. On the other side of the Atlantic the prevailing winter winds are from the north-west and bring to lower latitudes the temperatures of the Arctic regions, whilst our prevailing winter winds are from the south-west, and these blowing from lower and warmer latitudes across the Atlantic are the fundamental controlling factor of our climate. In summer the winds are rather from a west-south-westerly point. In all parts of our islands "blown trees" afford a demonstration more convincing than any statistics that our prevailing

Photo by A. Watt.

FIG. 2.—Trees near Edinburgh, on the road to Roslin by way of Fairmilehead. The branches have grown in an easterly direction, an effect of the prevailing westerly winds.

winds are from the Atlantic. Even in the neighbourhood of Edinburgh, which Stevenson describes as a "downright meteorological purgatory" in Spring when those east winds blow that brought the Northmen and the Danes to our shores "with many ships," you may find ocular proof of our general statement, as in the accompanying photograph (Fig. 2).

But, it will be asked, what of the Gulf Stream to which the mildness of our winters is so commonly attributed? Are not the waters on our west coasts warmer than those on the east, and is there not a well-marked ocean drift towards our western shores? In reply we would say that the Gulf Stream seems to have but little direct influence on our climate. That greatest of ocean rivers, whose course is so well defined, has almost entirely lost its momentum and practically disappeared a little to the east of the Newfoundland Banks. The warmer waters that wash our

western shores are part of a mere surface drift towards the north-east, caused by the prevailing south-westerly winds, and it is that surface-drift moving on beyond our islands that in conjunction with the prevailing winds causes the abnormally mild winters on the coast of Norway. It is true that a good deal of the Gulf Stream water does find its way across the Atlantic with this surface-drift current, but its influence must be small and cannot be disentangled and defined.[1]

Distribution of Temperature.

In discussing the variations in temperature conditions within our islands as we pass from north to south or from east to west we must bear in mind that elevation above sea-level is an important factor. We talk of the mild climate of Devonshire, having in our minds such places as Sidmouth, Dawlish and Torquay, but on the high land in the middle of Dartmoor the winter climate is as rigorous as that of Braemar. Of course nowhere in our islands are there such sudden contrasts as may be obtained in the Tropics as we rise over high mountains. Thus the famous railway in Peru, that crosses the Andes at an elevation of more than 15,000 feet, passes in a few hours through as wide a range of temperature conditions as would be met with in a journey at sea-level from the Equator to a point within the Arctic circle. The following description is excellent. "The first part of the journey is through fields of sugar-cane and cotton; at about 5000 feet a zone of fruit-trees is passed through: at 10,500 feet there is a district famous for its potatoes where little else is grown; above this the altitude is so great as to preclude the growth of anything but grass. At the highest point reached the snow lies on the mountain summits throughout the year, and the traveller may enjoy a snowstorm in the middle of summer (December-February). In the interior valley, farm produce is again seen growing. This whole succession of climates may be passed through in the short space of ten hours."

We may conveniently discuss temperature variations within our islands by the help of two maps representing the average distribution

[1] Mackinder in his *Britain and the British Seas* (p. 167) relegates the matter to a footnote. And see H. N. Dickson's admirable memoir on "The Circulation of the Surface Waters of the Atlantic" in the *Philosophical Transactions* of the Royal Society, 1901. We should, of course, have carried the analysis a step farther,—but that would have been beyond the scope of a popular address,—and have explained why our prevailing winter winds are from the south-west. Readers of the *Magazine* have recently had the explanation clearly stated in Miss Newbigin's paper on "The Study of the Weather as a Branch of Nature Knowledge" (vol. xxiii. pp. 627-648). It is there pointed out that our south-westerly winds are a consequence of the existence of a permanent area of high pressure near the Azores, and a permanent area of low pressure near Iceland. In a way the Gulf Stream does affect our climate, though only indirectly, for the low pressure area off Iceland which draws towards it the air from the Atlantic high pressure area is largely caused by the heaping up of warm waters in the North Atlantic. The whole matter may best be studied in chapters vii.-x. of R. de C. Ward's translation of Hann's *Climatology* (Macmillan and Co., 1903) with the help of various maps in Bartholomew's *Atlas of Meteorology*.

at midwinter and midsummer.[1] All accidental variations due to height have been eliminated and the observations for the various places reduced to sea-level by making an allowance of 1° Fahrenheit for every 300

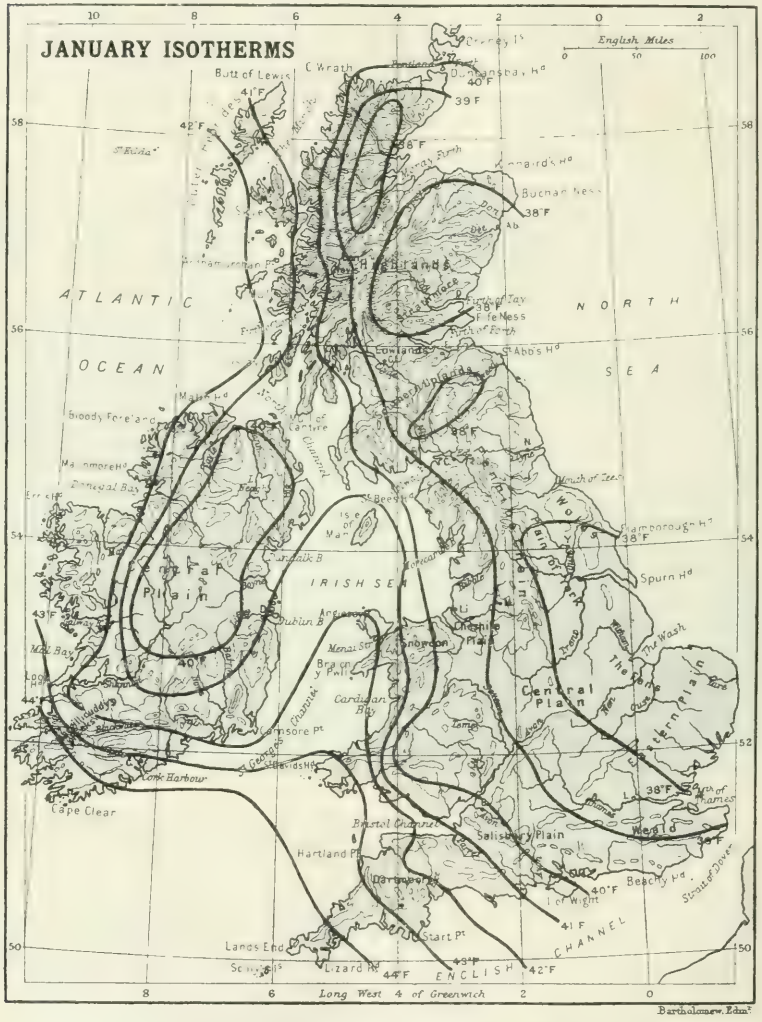


FIG. 3.—Showing the average distribution of temperature at midwinter when the accidental differences due to height above the sea have been eliminated.

feet of elevation. Braemar, for example, has an average January temperature of 34°, but it stands more than 1100 feet above the sea,

[1] Reproduced from Dr. Buchan's Maps in Bartholomew's *Atlas of Meteorology*. See also a paper by Buchan, "The Mean Atmospheric Pressure and Temperature of the British Isles," *Journal of Scottish Meteorological Society*, vol. xi. (1900).

and therefore we enter on our theoretical map a reading of about 38°. Isotherms are run through all places with the same temperature and we are in a position to enquire, say, whether there are any influences

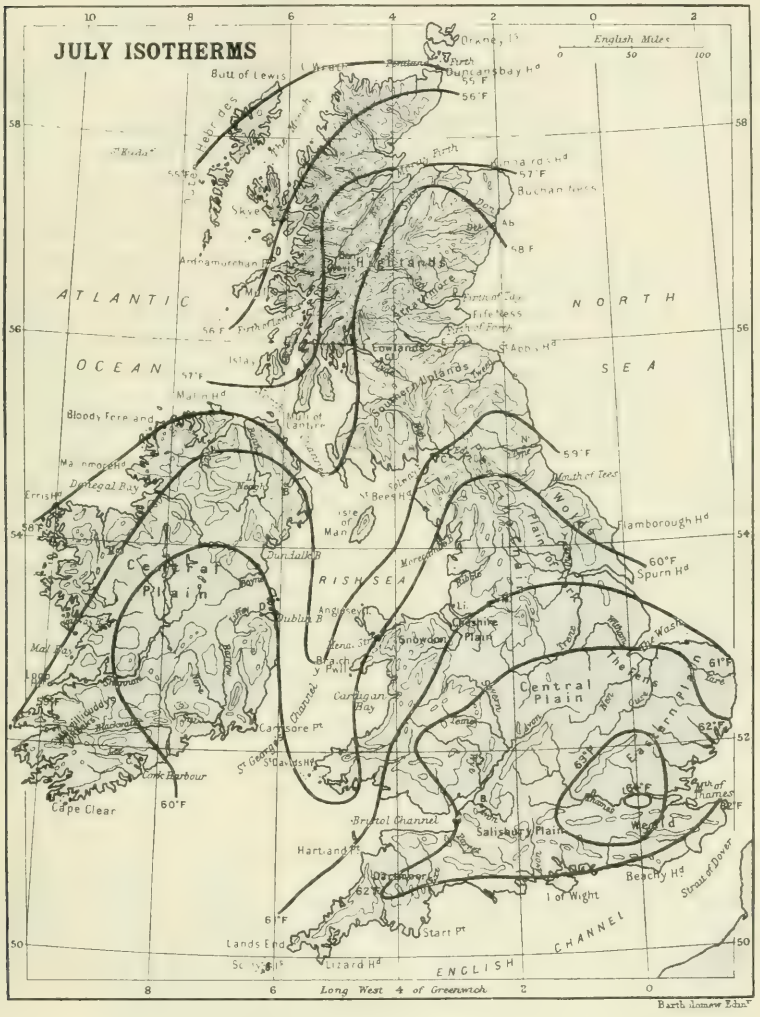


FIG. 4.—Showing the average distribution of temperature at midsummer when the accidental differences due to height above the sea have been eliminated.

at work that give our west coasts different temperature conditions from the east.

The January map (Fig. 3) shows clearly that in midwinter our west coasts enjoy much higher temperatures than the east. Along the east coast the isotherms of 38° and 39° are dominant and there is not much

to choose between Edinburgh and London. In the west of Ireland and the south-west of England, on the other hand, we have temperatures of 42° and upwards, whilst the extreme south-west of Ireland and the tip of Cornwall have temperatures above 44°. The most rapid change of climate is to be found along a line running from the mouth of the Thames to Land's End, where there is an increase of fully 6° in 300 miles. The run of the 38° lines in the North of Scotland and the Southern Uplands and of the 40° line in Ireland, indicate that in winter inland districts are colder than coast districts, whilst the upward sweep of the isotherms round the Isle of Man and Anglesey show the ameliorating influence of the waters of the Irish Sea and St. George's Channel.

In midsummer we find an entirely different relative distribution of temperature. The map of the July isotherms (Fig. 4) shows that now the controlling influence of the Atlantic gives to our western shores rather lower temperature than to our eastern, whilst in England it grows steadily warmer towards the south-east with a focus of maximum intensity around London. The rapid increase of temperature in passing from north to south is well marked, especially in the east, and now London is fully 5° warmer than Edinburgh. Again, the contrast between London and the south-west of Ireland is very striking. In January the mean temperature of Valencia is on the average about 6° above that of London, both days and nights being warmer by that amount. In July, on the other hand, we find the Valencia mean 5° below that of London, an effect due almost entirely to much cooler days, for there appears to be but little difference in the night temperatures. Indeed the days in July at Valencia are on an average as cool as are the days in the metropolis in the middle of May or towards the end of September. We may quote the January and July figures for the two places :—

AVERAGE TEMPERATURE.

JANUARY.

	Days.	Nights.	Mean.
London (Camden Square)	43·4°	33·8°	38·6°
Valencia	49·0°	40·1°	44·6°

JULY.

London (Camden Square)	74·3°	54·4°	64·4°
Valencia	64·0°	53·9°	59·0°

Considering our two maps together it is clear that the least difference between winter and summer is in the south-west of Ireland, where the isotherms shift by only 14°, and the greatest in the East Central district of England and the neighbourhood of London, where

the isotherms shift by 25°. The London curve, indeed, approaches the continental type and Fig. 5, in which the temperature variations throughout the year are shown for London and Valencia, is a faint reflection of Fig. 1 which showed the variations for Edinburgh and Irkutsk. For the sake of clearness it has been drawn on a vertical scale fully thrice as great as that of Fig. 1. We should add that Orkney and Shetland share with the south-west of Ireland a climate of moderate temperature variations, and that a comparatively small difference between day and night at all seasons is an invariable characteristic of districts where the difference between winter and summer is comparatively small. Thus we have—

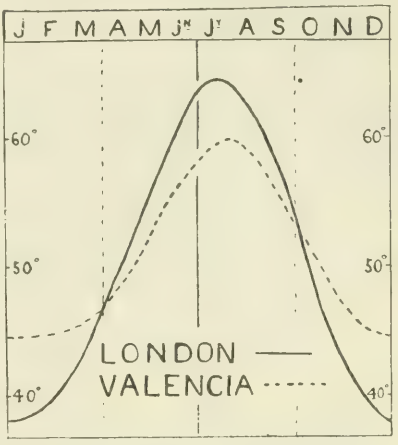


FIG. 5.—Mean Monthly Temperatures at London and Valencia.

MEAN TEMPERATURE.

	Deerness.	Valencia.	London.	Cambridge.
January	39·0°	44·6°	38·6°	37·5°
July	54·2°	59·0°	64·4°	62·4°
	15·2°	14·4°	25·8°	24·9°

MEAN DIFFERENCE BETWEEN DAY AND NIGHT.

	Deerness.	Valencia.	London.	Cambridge.
January	7·2°	8·9°	9·6°	11·7°
July	9·3°	10·1°	19·9°	20·0°

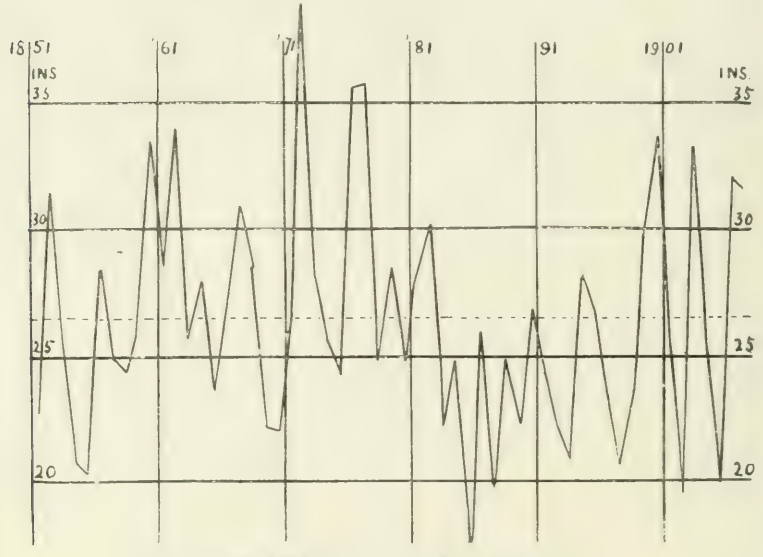
DISTRIBUTION OF RAINFALL.

A comparatively short series of observations is sufficient to determine the average temperature of a place, but in the case of rainfall we are dealing with an element so variable that records extending over only a few years may be very misleading indeed. For example, the accompanying diagram, Fig. 6, shows the fluctuations from year to year of the rainfall as registered at Charlotte Square, Edinburgh, from 1851 to 1907. The wettest year was 1872 with practically 39 inches, the driest 1885 with 17½ inches, and the average of the 57 years was 26½ inches. The seventies were a wet decade, which, if taken alone, would lead us to overestimate the rainfall of Edinburgh; the eighties a dry decade, that would lead us to underestimate it; and it is true for every place in our islands, as it is true for Edinburgh, that a comparatively long series of observations is required

before a reliable average can be determined.[1] Further, if we are to compare one place with another, we must utilise records covering the same periods of time.

But if we are to attempt a cartographical representation of the average rainfall of the British Isles, not only must the records employed be synchronous and for a fairly long period, but they must be for as large a number of places as well distributed as possible. A comparatively small number of stations enables us to discuss the general features of our climate as regards temperature, but there are such great regional variations in the case of rainfall that our information can hardly be too detailed. It is therefore with profound pleasure that we present the accompanying map (p. 181) by Dr. H. R. Mill, who is at once the greatest

Fig. 6.—Edinburgh Rainfall: 1851-1907.



Average Rainfall (- - - - - - - - - -), 26·43 inches.
Wettest Year, 1872 with . . 38·96 ,,
Driest Year, 1885 ,, . . 17·58 ,,

authority on all rainfall matters, and, as Director of the British Rainfall Organisation at its headquarters in London, the controller of an absolutely unique collection of records. Dr. Mill has drawn the map specially to illustrate this paper, and readers of the *Magazine* are to be congratulated on the great generosity which has placed in their hands what must remain for many years to come the standard rainfall map of our Islands. For the general principles on which such a map is based we can here only

[1] By a reliable average we mean one which would not be materially altered if the period of observation were extended. See A. R. Binnie's paper "On Mean or Average Annual Rainfall, and the fluctuations to which it is subject," *Proceedings of Institution of Civil Engineers*, vol. cix. Part iii. (1892).

refer to an exhaustive paper recently read by Dr. Mill before the Institution of Civil Engineers.[1]

Examining our map very generally, we find that it is based on observations for the 30-year period 1870-1899, and that three major grades of rainfall have been distinguished by a variety of shadings; very dry areas with an average rainfall of less than 25 inches have been left unshaded; areas with from 25 to 40 inches are lightly shaded; whilst the darker shading indicates regions with an average rainfall of 40 inches or over. At a glance it is apparent that western districts have a much heavier rainfall than eastern districts; that Scotland is, on the whole, wetter than England, and that only in Ireland has any eastern area a rainfall of more than 40 inches. Various other limits are defined by other "isohyets," or lines of equal rainfall. Thus between the unshaded area and the 40-inch contour we have "isohyets" of 30 inches and 35 inches, and within the heaviest shading "isohyets" of 50 inches, 60 inches, and thereafter for each additional 20 inches.

There appears to be no part of our islands with an average rainfall of less than 20 inches, though in the east of England one or two places, such as Shoeburyness and Spurn Head, have just about that amount. But a quite considerable part of England, amounting to nearly 20 per cent. of the entire area, must be classed as "very dry," with a rainfall below 25 inches. This lower limit occurs almost entirely in East Central England and in "a roughly triangular area round the Thames Estuary," whilst in Scotland there is only a very narrow coast strip round the head of the Moray Firth with an average rainfall of less than 25 inches. In Ireland no part of the country is "very dry."

When we come to examine the area covered by the next wettest zone, that with from 25-30 inches, we find that it embraces more than one-third of England and reaches the West Coast at the head of the Bristol Channel, and again at the Wirral Peninsula between the Mersey and the Dee. The greater wetness of Scotland as compared with England is obvious from the fact that whilst a rainfall of from 25-30 inches may be considered the prevailing rainfall of England, the 30-inch line in Scotland cuts off only a narrow strip of land along the East Coast, amounting to only 9 per cent. of the Scottish area. In Ireland there is only a patch round Dublin with less than 30 inches, and in Wales only a patch in the north-east.

Considering the next two zones together, we find just about one-third of Scotland with a rainfall of from 30-40 inches, rather less than one-third of England, about one-quarter of Wales, and about two-fifths of Ireland.

As regards the wet areas which are shaded in our map, we have the gradations defined, as already pointed out, by 50-inch and 60-inch lines, and then by lines for consecutive increments of 20 inches. The massing of these lines in the West Highlands, in the Lake District of England, and still more so in the Snowdon district of Wales, are evidence that

[1] "On Mean and Extreme Annual Rainfall over the British Isles," *Proceedings of Institution of Civil Engineers*, vol. clv. Part i. (1904).

these are the wettest regions of our islands, as indeed is notoriously the case. There are doubtless many places in our West Highland glens with an average rainfall of more than 100 inches, whilst the rainfall on the summit of Ben Nevis was as much as 160 inches. That, however, is exceeded by a mean of about 170 inches at the Stye on the northern side of Scafell. But wherever in our islands the actually heaviest rainfall occurs, there is no question that the greatest area of very heavy rainfall is situated in the West Highlands of Scotland, as is evident from our map, and from the following figures which we extract from Dr. Mill's paper :—

AREA WITH AVERAGE RAINFALL EXCEEDING 60 INCHES.

England,	768 square miles.
Wales,	1504 „ „
Scotland,	4960 „ „
Ireland,	1482 „ „

Thus the area in Scotland with an average rainfall exceeding 60 inches is about one-third larger than the aggregate of the similar areas in England, Wales, and Ireland.

A mere glance at our map is sufficient to show that the orographical features of our islands have a great influence on the distribution of the rainfall. The hilly or mountainous western districts are the wettest, and in England the coincidence of areas of much lower rainfall on the West Coast with breaks in the dominant mountain barrier is very striking. In Ireland there is less orographical diversity and apparently a more simply distributed rainfall. What is true of the country as a whole is more or less true of limited areas, and we would suggest that local scientific societies might do useful work by promoting rainfall observations within the areas they represent, and endeavouring to determine to what extent the physical features of various districts actually do influence the incidence of rainfall.

If the total average rainfall for the separate divisions of our Islands be calculated, and if we imagine it to be uniformly instead of irregularly distributed, we have the following comparative table :—

AVERAGE RAINFALL.

England,	31·62 inches.
Wales,	49·53 „
Isle of Man,	34·66 „
Scotland,	46·85 „
Ireland,	42·28 „
British Isles,	39·25 „

Distribution of Sunshine.

The distribution of sunshine cannot be pictured so fully as that of rainfall,[1] but some broad generalisations are possible. The amount

[1] See maps representing the average annual distribution in our islands, (1) by H. N. Dickson in Bartholomew's *Atlas of Meteorology*, and (2) more recently, by R. H. Curtis in *Symons's Meteorological Magazine* for September 1907.

AVERAGE RAINFALL
1870 TO 1899.
BY DR. HUGH ROBERT MILL
Director of "British Rainfall"
Shetland I.s
Fair I.
Orkney I.s
Butt of Lewis
C. Wrath
Thurso
Moray Firth
R. Spey
Nairn
Aberdeen
R. Dee
Skye
Barra Hd
R. Nevis
Braemar
Dundee
Mull
Firth of Forth
Islay
Glasgow
R. Clyde
Edinburgh
R. Tweed
Ayr
Dumfries
Newcastle
R. Tyne
Solway Firth
I. of Man
Flamborough Hd
Sligo
Westport
Cavan
Leeds
Hull
Ribble R.
Manchester
R. Humber
Holyhead
Liverpool
Sheffield
Lincoln
The Wash
Galway
Dublin
Birr
Derby
R. Trent
Norwich
Birmingham
R. Shannon
Limerick
Wexford
Waterford
R. Ouse
Cambridge
Killarney
Kenmare
Cork
C. Clear
Milford
Oxford
LONDON
R. Thames
Bristol Channel
Cardiff
Bristol
Dover
Southampton
Brighton
Beachy Hd
I. of Wight
Bude
Exeter
Portland
Land's End
Plymouth
Start Pt
Scilly Is.s
SCALE OF ENGLISH MILES

decreases rapidly as we pass from south to north, and slightly as we go from east to west, whilst everywhere great manufacturing centres pay for their commercial prosperity by a great lack of sunshine. We may conveniently give the average annual amount of sunshine for a few places throughout our islands. The statistics are all based on records obtained by means of the Campbell-Stokes Recorder.

AVERAGE ANNUAL SUNSHINE.

	Number of Hours.	Percentage of possible.
SCOTLAND—		
Deerness,	1178	27
Stornoway,	1271	29
Aberdeen,	1401	32
Edinburgh,	1373	31
Glasgow,	1095	25
Ben Nevis,	735	17
ENGLAND AND WALES—		
Newcastle-on-Tyne,	1066	24
Scarborough,	1393	32
Geldston (Norfolk),	1621	37
London (Westminster),	1144	26
Kew,	1467	33
Hastings,	1783	40
Ventnor,	1723	39
Torquay,	1731	39
Jersey,	1927	44
Douglas,	1600	36
Llandudno,	1456	33
Pembroke,	1642	37
IRELAND—		
Dublin (Phœnix Park),	1530	35
Birr Castle,	1350	31
Valencia,	1457	33

[The averages are mostly for a 25-year period ; that for Ben Nevis for 20 years ; that for Edinburgh (Blackford Hill) for 7 years.]

At the geographical extremes of our area we find the Channel Islands with fully 60 per cent. more sunshine than the Orkneys, whilst the general increase as we go from north to south is well marked and there is no question of the great superiority of England over Scotland. More numerous records confirm the generalisation suggested by our limited selection, that the fringe of the English Channel stands out conspicuously as the most favoured part of our islands. As regards Scotland, the north-eastern and the south-eastern counties appear to be the sunniest districts, sheltered as they are by the Grampians and the Southern Uplands respectively from the prevailing south-westerly winds which are largely drained of their moisture or cloud-forming element before these barriers are crossed. In spring, however, when east winds are so common, the west coast is frequently much sunnier than the east.

When we come to look at the seasonal distribution we may consider the records from two points of view. Suppose, for example, we wish to compare the climate of the Orkneys with that of the Channel Islands as regards sunshine, then, say in June, we have the following figures for Deerness and Jersey:

Average sunshine at Deerness in June = 154 hours.
Average sunshine at Jersey in June = 241 hours.

Thus in June, Jersey on an average enjoys nearly three hours a day more sunshine than Deerness. Such a statement, however, by no means fully represents the superiority of the Channel Islands over the Orkneys, for it must be remembered that as Jersey and Deerness differ in latitude by more than 10 degrees, the sun in June is above the horizon on an average for about two hours a day longer at Deerness than at Jersey, the relationship being reversed in December. Hence not only has Deerness an absolutely much smaller allowance of sunshine in June, but its disadvantage is really enormously greater than is indicated by the above figures when we consider the longer days of the more northerly latitude. In point of fact, whilst Jersey enjoys just half the amount of sunshine that would be recorded were the sky absolutely cloudless throughout the month, Deerness receives not much more than one quarter of this theoretical "total possible." Thus we have:

Average sunshine at Deerness in June = 28 per cent. of total possible.
Average sunshine at Jersey in June = 50 per cent. of total possible.

We give in the following table the records for the two places for each month of the year, expressed in this double manner:—

AVERAGE SUNSHINE IN THE ORKNEYS AND THE CHANNEL ISLANDS.

	Deerness.	Jersey.	Deerness.	Jersey.
	Hours.	Hours.	Per cent. of possible.	Per cent. of possible.
January,	27	67	13	25
February,	54	92	21	33
March,	104	149	29	41
April,	149	189	35	46
May,	179	250	35	53
June,	154	241	28	50
July,	139	250	26	52
August,	119	243	25	55
September,	109	182	29	49
October,	81	126	26	38
November,	38	76	17	28
December,	25	62	13	25
	1178	1927	27	44

If for convenience we represent the variations in amount at the two places in diagrammatic form, as in Fig. 8, it is obvious at a glance that

not only does the Orkney curve run consistently below that for the Channel Islands, but that it is essentially different in type. At Deerness there is a well-marked May maximum, and this is typical of Scotland and still more so of Ireland. As we go southwards the Orkney type gradually passes into the Channel Island type, where on an average sunshine varies but little in amount throughout the summer months.

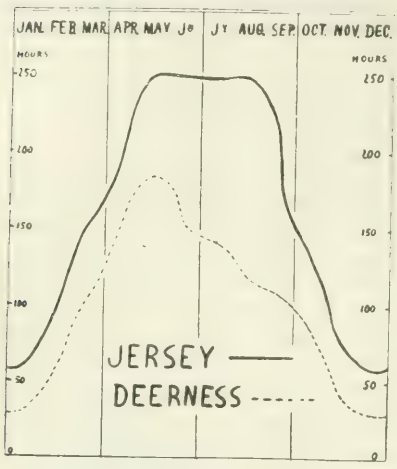


FIG. 8.—Average sunshine at Jersey and Deerness.

The low figures for Glasgow, Newcastle and London in our general list are characteristic of large centres of population generally, and in this connection we may refer to a lecture[1] by Dr. W. N. Shaw, F.R.S., Director of the Meteorological Office, in which the London sunshine statistics were utilised as a measure of the gravity of the smoke nuisance in the metropolis. The London figures were compared with the average of those available for other places in the southern counties of England, and at different times of the year. The following was the result :—

	Dec.	Mar.	June.	Sept.
London, ...	9	23	36	34 per cent.
Average of Southern England, . .	21	38	43	44 per cent.
London loss, approximate, . . .	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{4}$

A comparison of all the months showed that, speaking roughly, London, as compared with adjacent country districts, loses about one-half of its sunshine from November to February, from one-third to one-fourth in March, April, September, and October, and about one-sixth from May to August. Dr. Shaw says :—"The contrast of the figures for summer and winter is remarkable. As regards smoke, the difference rests chiefly on the fact that there are fewer domestic fires in summer, and that we may therefore legitimately conclude that the domestic smoke is the most serious item to be reckoned with in considering the smoke problem." Much sunshine is lost in the metropolis owing to the occurrence of fog, but in winter, even on windy days when the formation of fog in the strict meteorological sense of the term is impossible, it is "found that the Victoria Tower at Westminster and

[1] "The Treatment of Smoke : a Sanitary Parallel," published in *Nature*, vol. lxvi., 1902.

St. Paul's Cathedral—two buildings a mile and a half apart as the crow flies—are invisible the one from the other till March is well established." But it is fair to point out that the above figures must be considered as referring only to the more central districts of London, for the winter figures for Greenwich and Kew are much higher than those for Westminster.

The sunshine records of Ben Nevis were always of interest in comparison with those of low-level stations. It was known beforehand that the mountain summit was often wreathed in mist when the surrounding atmosphere was clear; but the amount of sunshine was found to be quite unexpectedly small, the high-level observatory averaging about an hour a day less than even Glasgow.

Amongst the countries which have followed the lead of Great Britain in adopting the Campbell-Stokes instrument, Switzerland has been, perhaps, the most enterprising. The brilliant winter sunshine of the Upper Engadine has long been appreciated by the Swiss as a great national asset: the records now give an exact measure of this golden treasure. In the accompanying diagram (Fig. 9), we give a comparison of the sunshine curves for Davos Platz and for Hastings, which is perhaps as sunny as any place in the south of England. The two places have on the average about the same amount of sunshine in the course of the year, but from about the spring till about the autumnal equinox the balance is largely in favour of Hastings, whilst during the winter half-year Davos is very much sunnier.

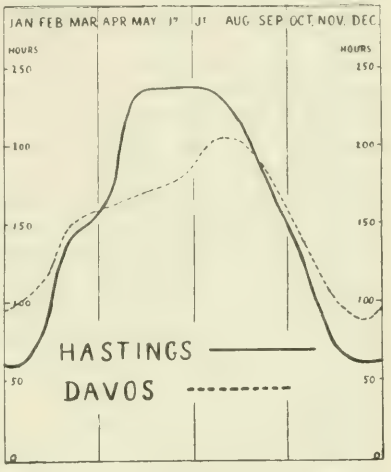


FIG. 9.—Average sunshine at Hastings and Davos.

HAS OUR CLIMATE CHANGED?

The question whether or not our climate has changed within historic times is probably one to which no conclusive answer can be made, though there appears to be a very general opinion that our winters have on the whole grown milder. The proverbial "oldest inhabitant" of each succeeding generation will doubtless always maintain that this is so; but his recollections are hardly convincing evidence, nor do instrumental weather records help us much. One argument in favour of the general opinion that appears to carry considerable weight is based on the fact that the Thames at London is now never frozen over, whereas in the sixteenth and seventeenth centuries we read of its being frozen for two or three months at a time. There are reliable accounts of "frost fairs" being held on the ice, at which oxen were roasted whole, and Evelyn,

the famous diarist, makes such a definite statement as that "coaches plied from London to Westminster" on the frozen waterway. But now the Thames at London has not been fairly frozen over for nearly a century. Surely, therefore, our winters are milder now than then. It may be so, but we do not recognise here any absolute proof of the fact. The Thames of to-day cannot be compared with the Thames of two or three centuries ago, for the simple reason that Old London Bridge, which was removed about eighty years ago, was a bridge of many arches, and acted as a sort of half tidal dam, greatly lessening the rise and fall of the river, and making it much more easily frozen than to-day, when the flow and ebb of the tide is uninterrupted.

Probably it is true for our islands, as it seems to be true for the Continent of Europe, that there are well-marked oscillations of climate, but no evidence of either deterioration or improvement. Thus, in some districts of France, the date of the vintage each year—a clear index of the character of the preceding summer—is known as far back as the fourteenth century. The dates vary within a limit of some weeks, but are on an average neither later nor earlier than in former times. Again, in Russia we have a great country whose internal trade is largely dependent on its navigable rivers, which are frozen during the winter months. The dates of the opening and closing of these rivers are known with tolerable certainty for the last two hundred years, and appear to show that exceptionally cold years occur at intervals of from thirty to thirty-five years and exceptionally warm years within a similar period.

Speculations as to changes of climate are always interesting, and not always unprofitable, and we may conclude by referring to an eloquent passage in an early chapter of *The Decline and Fall of the Roman Empire*, where Gibbon argues in favour of the view that Europe was much colder formerly than in modern days. "The general complaints," he says, "of intense frost and eternal winter are perhaps little to be regarded, since we have no method of reducing to the accurate standard of the thermometer the feelings or the expressions of an orator born in the happier regions of Greece or Asia." But the Rhine and the Danube were frequently frozen over, so that armies and heavy baggage could cross "over a vast and solid bridge of ice," and "modern ages have not presented an instance of a like phenomenon." That would be a valid argument; but when Gibbon goes on to point out that the reindeer, an animal "that supports and even requires the most intense cold . . . was a native of the Hercynian forest, which then overshadowed a great part of Germany and Poland," is not now found to the south of the Baltic, and advances this as an argument that the winters of Europe have grown milder, surely that is inconclusive—for would not the reindeer in any case have retreated northwards before the march of civilisation?

BATHYMETRICAL SURVEY OF THE FRESH-WATER LOCHS OF SCOTLAND.[1]

Under the Direction of Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., etc., and LAURENCE PULLAR, F.R.S.E.

PART XIII.—LOCHS OF THE NESS BASIN.

FIRST PART.

THE basin of the river Ness is one of the most important of Scottish river-basins, not so much on account of the area drained, which is small when compared with the areas drained by the Tay, Tweed, Clyde, and Spey, for instance, but because it includes within its boundaries the largest body of fresh water in Scotland (Loch Ness), as well as several other large lochs and numerous small ones. The basin extends from the mouth of the river Ness, at the junction of the inner Moray Firth with the Beauly Firth, in lat. 57° 30′ N. to lat. 57° N., south of Loch Quoich, and from long. 5° 30′ W., west of Loch Quoich, to long. 4° 10′ W., south-east of Inverness. The total area, as measured with the planimeter on the 1-inch Ordnance Survey maps, is about 722 square miles, and of this by far the larger portion drains into Loch Ness, for the area draining into the river Ness, and into Loch Ashie which flows directly into the river Ness, is only about 36 square miles. With the exception of Loch Ashie, the superfluent waters from all the lochs within the basin find their way into Loch Ness, so that the total area draining into Loch Ness is about 686 square miles. The area drained by the tributary lochs, to be dealt with in subsequent papers, is about 354 square miles, leaving about 332 square miles draining directly into Loch Ness, independent of the other lochs.

The principal river-systems within the basin lie to the west of Loch Ness, viz. the Enrick, which flows through Glen Urquhart into Loch Ness at Urquhart Bay, where it is joined by the shorter river Coiltie; the Moriston, with its tributaries the Clunie and the Loyne, which flows through Glen Moriston into Loch Ness at Invermoriston; the Garry, with its tributaries the Quoich and the Kingie, which flows through Glen Garry into Loch Oich at Invergarry, and thence by the Oich into the head of Loch Ness at Fort Augustus. To the south of Loch Ness lies the Tarff, also entering Loch Ness near Fort Augustus; and to the east lie the Foyers, with its tributaries the Breinag and the Fechlin, which flows into Loch Ness at Foyers, and the Farigaig which enters Loch Ness at Inverfarigaig. Finally, to the north-east of Loch Ness lies the Allt Mor (or Big Burn), draining Loch Ashie, which flows into the river Ness two or three miles below Inverness, while the river Ness, after issuing from Loch Dochfour, at the northern end of Loch Ness, follows a winding course of about six miles, and pours its waters

[1] Abbreviated from a paper published in full, with maps and figures, in the *Geographical Journal*, July 1907.

into the Moray Firth. Besides these, there are many shorter streams and burns flowing directly into Loch Ness, or into the tributary rivers or lochs.

The staff of the Lake Survey sounded thirty-three lochs within the Ness basin, while a number of small lochs could not be surveyed for lack of facilities. These lochs vary in size, from the little Loch nan Losganan, covering an area of only seven acres, and containing only a million cubic feet of water, to the mighty Loch Ness covering an area exceeding 20 square miles, and containing many thousands of millions of cubic feet of water. None of the other lochs in the basin can be compared with Loch Ness, neither as regards area, volume, nor depth, but still a few of the lochs are of considerable importance. For instance, Loch Quoich is seven miles in length, while Loch Garry and Loch Mhor are nearly five miles in length, and Loch Clunie and Loch Oich exceed four miles in length. Loch Quoich, again, covers an area of nearly three square miles, while Lochs Garry, Mhor, and Clunie exceed a square mile in area. Two of the lochs (Quoich and Garry) exceed 200 feet in depth, and three other lochs (Oich, Clunie, and nan Lann) exceed 100 feet in depth, while no fewer than twelve others include depths exceeding 50 feet.

The basin lies almost entirely in Inverness-shire, but a small portion of Ross-shire extends within the basin on its western border, the boundary-line running along the centre of West Loch Loyne and for a short distance along the centre of East Loch Loyne, thence turning northward it crosses Loch Clunie in its central part; thus Lochs Loyne and Clunie lie partly in Ross-shire and partly in Inverness-shire, while the little Loch Beag, at the west end of Loch Clunie, is the only one lying wholly in Ross-shire. The scenery of the basin is varied, and as fine as anything to be seen in the Scottish highlands: towards the north the ground is low, but proceeding southwards it becomes more elevated, culminating on the south-western borders in several giant peaks exceeding 3000 feet in height, and on the south-eastern borders in mountains slightly less elevated. The district is a veritable sportman's paradise, the deer-forests, grouse-moors, and fishings (both in river and loch) being of the best. Trout abound in nearly every loch, with salmon and *salmo ferox* in some of the larger lochs, and char in some of the smaller lochs lying to the east of Loch Ness; the fishing in most of the lochs is preserved.

Loch Ness.—Loch Ness formed the subject of discussion at a meeting of the Research Department of the Royal Geographical Society on January 18, 1904, and preliminary notes on the bathymetry, temperatures, and seiches were published in their *Journal* in October 1904.[1] Since then many temperature and seiche observations and supplementary soundings have been taken, and the preliminary measurements and calculations have been carefully revised, the final results being given in this paper. Loch Ness is one of the best known of the larger Scottish lochs, since it forms a considerable part (nearly one-half) of the water-

[1] *Geographical Journal*, vol. xxiv. p. 429.

way known as the Caledonian Canal, which occupies the great glen running in a north-east and south-west direction from the Moray Firth on the east coast of Scotland to Loch Linnhe on the west coast, thus cutting Scotland into two portions. Through the Caledonian Canal thousands of visitors are carried each season on the route between Inverness and Fort William, and the splendid scenery of the canal and surrounding district has furnished a theme for many pens. The absence of islands in Loch Ness is a striking characteristic, and gives a touch of monotony to the grand and sombre scene, as one sails up or down; the little Cherry island, lying at the opening of Inchnacardoch bay near the head of the loch, is invisible except at close quarters. Castle Urquhart, on its rocky headland at the south side of Urquhart bay, forms a picturesque and noteworthy landmark.

In his journey to the Western islands of Scotland in the autumn of 1773, Dr. Johnson travelled along the shores of Loch Ness, which, he says, is in some places 140 fathoms deep, and he remarks further that "Natural philosophy is now one of the favourite studies of the Scottish nation, and Loch Ness well deserves to be diligently examined." After the lapse of 130 years this has been done, and it is proposed in this place to summarise the results obtained by the staff of the Lake Survey during their prolonged and "diligent examination" of Loch Ness.

The survey of Loch Ness was commenced on April 2, 1903, and by the end of that month the preliminary survey was completed, but subsequently, at various periods during the years 1903 and 1904, many additional lines of soundings and numerous isolated soundings were taken, some of them in connection with the work of collecting samples of the deposits from all parts of the loch, others in connection with the work of taking temperature at various depths in different parts of the loch. The total number of soundings recorded is about 1700, but some of them have been omitted on the map of the Survey to avoid overcrowding. On April 1, 1903, the level of the surface of the loch was determined from bench-marks as being 52·6 feet above the sea, and to this datum-level all soundings have been reduced. A levelling-staff was erected first at Fort Augustus, then at Invermoriston, Foyers, and Temple piers, and the height of the water on this staff was read daily during the progress of the survey, so that the variations in level from day to day, and the variations from the starting-point, were readily known. These staff readings showed that the water fell, gradually but irregularly; by April 15 it was 1 foot lower, and by the 18th it was $1\frac{1}{2}$ feet lower, than on April 1.

Loch Ness proper may be said to extend from the head of the loch at Fort Augustus to the narrows at Bona ferry, a distance of $22\frac{3}{4}$ miles following the axis of maximum depth. This figure is inferior to the length of Loch Awe ($25\frac{1}{2}$ miles), and slightly in excess of the length of Loch Lomond ($22\frac{2}{3}$ miles); if we regard the small basin of Loch Dochfour, which is continuous with Loch Ness at its northern end, as forming part of the loch, then the total length, from the exit of the river Ness to the head of the loch, is about $24\frac{1}{4}$ miles.

In this place it is proposed to include Loch Dochfour in dealing with

Loch Ness; it is a basin about $1\frac{1}{2}$ miles in length, with a maximum depth of 50 feet in the wide central portion, whence it narrows towards the two ends, the southern narrows leading into Loch Ness, and the northern termination being divided into two branches, the eastern branch forming the river Ness, and the western branch the continuation of the canal. With a strong south-westerly wind there is a surface current from Loch Ness into Loch Dochfour through the narrows at Bona ferry, and, if long continued, the water becomes banked up in Loch Dochfour, and gives rise to a return current along the bottom into Loch Ness; with a strong wind from the north-east the surface current sets in the opposite direction, *i.e.* from Loch Dochfour into Loch Ness. Cut off from the western margin of Loch Dochfour, by embankments carrying the towing-path of the canal, are two small basins, one called Abban water, having a maximum depth of 9 feet, the other without a distinctive name, having a maximum depth of 23 feet; they stand at the same level as Loch Dochfour, the water evidently percolating through the embankments.

Loch Ness may be said to be fairly uniform in breadth, though varying to some extent, but on the whole its shore-line is very regular when compared with other large lochs. The upper portion between Fort Augustus and Foyers for about 10 miles is under a mile in width, except at the opening of Glen Moriston, where the breadth slightly exceeds a mile. The portion between Foyers and Castle Urquhart for about 5 miles is almost exactly a mile in width, while the lower portion between Castle Urquhart and Torr point for about 5 miles exceeds a mile in width. The widest part of the Loch is at Urquhart Bay, from the mouth of the river Enrick due east to the opposite shore, where the width is 2 miles. The portion of the loch from Torr point to Bona ferry for about $1\frac{1}{2}$ miles varies in width from a half to a quarter of a mile, and the central portion of Loch Dochfour is about a quarter of a mile in width. The mean breadth of the entire loch is nine-tenths of a mile, or less than 4 per cent. of the length; a smaller percentage of mean breadth to length has been recorded only in Loch Shiel and Loch Shin, with $2\frac{1}{2}$ and 3 per cent. respectively.

The waters of Loch Ness cover an area of nearly 14,000 acres, or $21\frac{3}{4}$ square miles. Among the Scottish fresh-water lochs this is exceeded only by Loch Lomond, which has a superficial area of nearly $27\frac{1}{2}$ square miles. As already stated, the area draining directly into Loch Ness is about 332 square miles, while its total drainage area, including the area draining into all the tributary lochs, is about 686 square miles—an area over thirty times greater than that of the loch.

The maximum depth observed by the Lake Survey staff in Loch Ness was 754 feet, about a mile due south of Castle Urquhart in the centre of the loch. A greater depth than this has been recorded in only one Scottish loch, viz. Loch Morar, which has a maximum depth of 1017 feet, and after Loch Ness come Loch Lomond and Loch Lochy, with maxima of 623 and 531 feet respectively.

The volume of water contained in Loch Ness is estimated at 263,000 millions of cubic feet, or $1\frac{3}{4}$ cubic miles. In no other Scottish loch does

the bulk of water amount to a cubic mile—in fact Loch Ness contains about three times as much water as the two lochs which most nearly approach it in this respect, viz. Loch Lomond with 92,800 million cubic feet, and Loch Morar with 81,500 million cubic feet. The largest volume of water recorded by Dr. Mill among the lakes of the Cumberland district is only 12,250 million cubic feet. As far as we are aware, the volume of water contained in the large lakes of Ireland has not yet been carefully worked out, but, taking Loch Neagh, for instance, which is said to cover an area of 153 square miles (or seven times greater than the area of Loch Ness), and to have a maximum depth of only 48 feet, a rough calculation will show that the bulk of water in Loch Neagh must be less than that in Loch Ness. It seems quite possible, therefore, that Loch Ness may be the largest body of fresh water, not only in Great Britain, but in the United Kingdom.

Correlated with the enormous volume of water in Loch Ness is the high value of the mean depth, which works out at 433 feet for the entire loch. This far exceeds that of Loch Morar, viz. 284 feet, which comes next in this respect. The mean depth of Loch Ness is equal to 57·4 per cent. of the maximum depth—a higher percentage than has been observed in any other deep loch, the nearest approach to it being in the case of Loch Avich, with a maximum depth of 188 feet and a mean depth of 98 feet, the percentage being 52·4. It is true that in some shallow flat-bottomed basins the percentage of mean depth to maximum depth exceeds that in Loch Ness; as, for instance, Loch Watten in Caithness (70 per cent.), and Loch Bruadale in Lewis (74 per cent.), but the maximum depths are here only 12 feet and 6 feet respectively. Except for Lochs Ness and Avich, in all the deep Scottish lochs, *i.e.* those having depths exceeding 100 feet, the mean depth is less than one-half of the maximum depth, the percentage varying from 19·4 in Loch Shiel, and 19·5 in Loch Lomond, to 49·4 in Loch Lungard, and 49·6 in Loch Suanival (Lewis).

It has been stated that the surface of Loch Ness stands about 52 feet above mean sea-level, so that by far the greater portion of its floor falls below the level of the sea.

An inspection of the bathymetrical map of Loch Ness shows (1) the comparative simplicity of the basin; (2) the deep shore-slope throughout the greater part of the loch; and (3) the large area of the lake-floor covered by very deep water. The 100-feet, 200-feet, 300-feet, 400-feet, and 500-feet contours are continuous, and only the 600-feet and 700-feet contours are interrupted by a shoaling opposite the entrance of the river Foyers, probably due to the deposition of material brought down by that river. This shoaling is covered by 515 to 524 feet of water, and both to the north-east and south-west the bottom sinks to depths exceeding 700 feet.

The 100-feet basin is about 22½ miles in length, the southern extremity approaching to within 100 yards from the shore at the entrance of the river Tarff, and the northern extremity extending into the narrow part of the loch beyond Torr point, approaching to within a quarter of a mile from Bona ferry.

The 200-feet basin is $21\frac{2}{3}$ miles in length, approaching to within 150 yards from the Monastery boathouse slip at Fort Augustus, quite close to the south-western shore off the entrance of the river Oich, and extending beyond Torr point on the north to within less than a mile from Bona ferry.

The 300-feet basin is $20\frac{3}{4}$ miles in length, extending from less than 300 yards from the Monastery boathouse slip on the south to just beyond Torr point, or $1\frac{1}{2}$ miles from Bona ferry, on the north.

The 400-feet basin is 20 miles in length, distant over a quarter of a mile from the Monastery boathouse slip on the south, and about three-quarters of a mile from Torr point, or over two miles from Bona ferry, on the north.

The 500-feet basin is about $18\frac{1}{2}$ miles in length, distant less than a mile from the Monastery boathouse slip on the south, and about $1\frac{1}{2}$ miles from Torr point on the north. The southern extremity of this basin differs somewhat from the usual truncate form, partaking of a rectangular character.

The two 600-feet basins are separated by an interval of little over half a mile, and are almost exactly equal in length, both of them slightly exceeding eight miles in length. The northern one is distant about two miles from Torr point, and the southern one less than two miles from the Monastery boathouse slip at Fort Augustus.

The two 700-feet basins are separated by an interval of nearly $2\frac{1}{2}$ miles, the northern one being nearly twice as long as the southern one, and including the maximum depth of the loch—754 feet. The northern basin is $6\frac{1}{2}$ miles in length, and distant about $2\frac{3}{4}$ miles from Torr point, while the southern basin is $3\frac{1}{3}$ miles in length, and nearly 6 miles distant from Fort Augustus. The maximum depth recorded in the southern basin was 739 feet near the southern end of the basin, while towards the northern end of the basin a depth of 735 feet was recorded, the intervening soundings being slightly shallower.

These details show how extremely symmetrical Loch Ness is in all its bathymetrical characteristics. All the contour-lines, except the deepest one, approach rather closer to the southern than to the northern end of the loch, but in the case of the 700-feet contour this is reversed.

The shore-slope on both sides of the loch is nearly everywhere steep. Gradients exceeding 1 in 1 are of frequent occurrence, and in certain places the slope approaches the precipitous. Near the southern end of the loch, off the south-western shore at the entrance of the river Oich, a sounding in 204 feet was taken about 100 feet from shore, but the steepest slopes were observed off the north-eastern shore in the vicinity of the Horseshoe craig, where a sounding in 236 feet was taken about 100 feet from shore; another in 175 feet about 50 feet from shore; and, off what is known as the Cormorant rock, a sounding in 206 feet was taken about 50 feet from shore. This last-mentioned sounding gives a gradient exceeding 4 in 1, or an angle of about 15° from the perpendicular.

The steep shore-slope is further seen by the manner in which the

contour-lines of depth as a rule hug the shores, leaving a comparatively very large area of the lake-floor along the central line of the loch covered by very deep water. This is strikingly shown by the fact that nearly one-half of the entire basin is covered by more than 500 feet of water, and over one-third by more than 600 feet of water.

The most remarkable point about the areas between the contour-lines is that the two deepest zones are larger than any of the other shallower zones, the deepest zone of all, though the interval between the 700-feet contour and the maximum depth is only half the usual interval between the contour-lines, being the largest of all. Such a distribution of the depth-zones has not been observed in any other loch, and is a reversal of the usual rule of the shallowest zone being the largest one, though one or two exceptions to this rule have been recorded, as, for instance, in Loch Treig, where the zone between 200 and 300 feet is larger than either of the two shallower zones, and in Loch Lochy, where the zone between 100 and 200 feet is a little larger than the shore-zone. In the deepest of all Scottish lochs, Loch Morar, the shore-zone is equal to 42 per cent. of the total area, and the second zone between 100 and 200 feet is equal to 13 per cent., while of the deeper zones not one exceeds 9 per cent. of the total area. In Loch Lomond, again, the shore-zone is equal to 68 per cent. of the entire area, and the second zone between 100 and 200 feet is equal to 16½ per cent., while the deeper zones are in each case less than 6 per cent. In Loch Ericht the shore-zone is equal to 34 per cent., the second zone between 100 and 200 feet is equal to 25 per cent., and the third zone between 200 and 300 feet is equal to 19 per cent. of the total area, the deeper zones in each case not exceeding 10 per cent. In Loch Tay there is a regularly decreasing percentage in the zones of depth from the shore into deep water, the numbers for each zone at intervals of 100 feet being respectively 30, 23½, 21, 15½, 9.

ABOVE THE VICTORIA FALLS.

By Aubyn Trevor-Battye, M.A., F.L.S., etc.

The Chartered Company's recently expressed determination to found a township at the Victoria Falls would result, in the near future, in a closer exploitation of the land which lies up the river to the north. It may therefore be of interest to give here a sketch of part of that country, of the river, and of the natives who live along its banks.

The Falls themselves and their zigzag rapids are formed by faults in the volcanic rock; and this basaltic formation crops up at intervals, for some sixty miles or thereabouts, above the Falls. This rock forms islands, and as it were bars, across the stream, which make rapids that are from some fifty yards to perhaps a quarter of a mile in duration.

These rapids are always difficult, and at some conditions of the water dangerous, to navigate. I have not seen them when the river is running high, but at low water (that is to say in October, before the rains) they are sufficient to prevent the passage of any boats but those of the very shallowest draught: and perhaps no boat except the flat-bottomed dug-out of the natives could safely pass them then. It is therefore probable that for some time to come, until proper *portages* have been engineered, all the water-borne trade of a new settlement must depend on native services. Doubtless such trade at the beginning would be very small, confined to fish and perhaps maize. But in view of the sagacity and docility of these river people there would seem to be nothing to prevent them from becoming useful agriculturists, and up to a certain point possibly even craftsmen. Both Lewanika and Litia his son are quite shrewd enough to recognise such chances as may offer themselves. Lewanika's cattle could easily supply the town with milk, and there is no reason why a trade in cheese should not be developed. The natives, under proper instruction, would be quite capable of learning an industry like this, which indeed may be said to lie easily and naturally within their range.

To return to the river. These bars of rock which span the stream, are carried on inland, and sometimes for a considerable distance on either side of the river. And since the outcrops are parallel, they tend to divide up the adjacent land in gridiron fashion. Wherever the rocks crop up, trees flourish. The highest islands, those above high-water mark, are clothed with palms and a dense tangle of tropic growth, which, so long as the influence of the damp river air is directly felt, is continued on into the land on either side. But as one follows a ridge inland, the tropical character of the vegetation is gradually lost, the jungle thins out, until finally where the outcrop finishes, only acacias flourish. These acacia groves are very beautiful and very light in their effect: they are particularly striking along the southern side of the Linianti, just south of the German territory. Between these ridges the land is treeless and grass-covered. In some districts indeed, if one walks by the side of the river one will be alternately traversing forest strip and grassy glade as sharply defined as if artificially laid out. But the underlying cause is always the alternation of rock with clay or sand.

About sixty miles above the Falls, *i.e.* about eight miles above Kazungula,[1] the rock disappears, and thence to Sesheke all is a flat plain of clay and sand formation. At low water the channel is usually confined to a deep stream some twenty yards wide, while the rest of the broad river consists of shallows often but a few inches deep. Over these shallows it is just possible to punt the dug-outs, and in the month of October the natives avoid the deep water as much as possible, because of their dread of the hippos, which then have young ones, and are therefore dangerous.

[1] All distances are merely given by guesswork but may, I think, be taken as roughly correct.

On the proper right bank lies the tip of that curious finger of German South-West Africa which it is generally believed was secured by Germany as a "jumping-off" point for further acquisitions, frustrated by the prescience of Cecil Rhodes. This along a great part of its river front is covered with bush, and appears to be very swampy. These swamps are possibly a continuation of those which occupy so much of the left bank of the Linianti (near the border of Bechuanaland) as it approaches the point where it enters the Zambesi.

The great plain which lies on the right of the river as you ascend, is covered after the rains with a crop of fresh green grass which attracts many antelopes. Roan antelope, reed-buck, blue wilde-beeste and zebras were feeding there when I visited it in October. At that time of the year, however, great patches had been swept by fire. There appear to be a fair number of lions in the district, although, of course, they are not nearly so numerous as in some other parts of Africa, where the game is vastly more abundant. There are, I understand, districts between the Zambesi and the Kafue where game and lions are far more numerous. But according to the natives one lot of seven, and another of five lions were perfectly well known to them in the district of which I am speaking; indeed lions visited a kraal where I stayed and carried off two cows. The following night they came again, but the cattle kraal had in the meantime been built up more carefully, and though they ran round and round the enclosure for the best part of the night and greatly alarmed the cattle, they did not on this second occasion succeed in stampeding any of them. I refer to this incident in order to emphasise the point that though I had not before seen a sign of a gun in any kraal, boat, or native's hands, no sooner was there that night an alarm of lions than every man appeared with a gun or rifle of some sort.

The country as described is continued as far as Sesheke, that is to say for a hundred miles or so above the Victoria Falls. Sesheke was formerly the capital of Lewanika, king of Barotseland, and at the time of my visit was, and I believe is still, the home of Litia his son, and of the king's sister. Lewanika himself now lives at Lialui further up the river. Sesheke is chiefly of interest to us from the fact that it was the place from which David Livingstone set out on the memorable journey that resulted in his discovery of the Falls. It is probably but little altered since his day, and it seemed to me that an old solitary thorn-tree under which the natives congregate to-day must be the identical great "camel-thorn tree" under which he held his last service and indaba before he left. The village consists of the usual collection of grass-covered huts with their screen protections, but contains in addition to these Litia's larger home—half house, half kraal—his aunt's house, the house and office of the Assistant District Commissioner, and some deserted missionary buildings. I was assured that after being there for some years this mission had been given up as hopeless; only one convert had been made, though that one was Litia. Litia unlike his father, is said to have but one wife. While he sat on a chair to speak to me his wife squatted on the floor by his side, wearing on her

left arm five of the royal ivory armlets. Litia is a highly intelligent man, who gets his guns and cartridges from Bond Street. It was curious to see him sitting there in the dress of an English country gentleman while the village was filled with his father's naked subjects. Lewanika, you will remember, was brought to London to see King Edward's coronation, and it is reported that, impressed by all that he had seen, he returned thoughtful and silent to his capital, but that when his subjects were assembled in thousands to hear him, he at length broke silence with the words, "You are all baboons. Simply that."

These men are called Batoka. They are really a mixed tribe. The story of how this admixture came about is an interesting one. It is connected with the names of two great Bantu chiefs, Sibituane and Mozilikatze. They both came from the south. In 1824 Sibituane, driven by the Griquas out of the country near Kuruman, pushed up through the Kalahari desert into Bechuanaland and finally founded his tribe of the Makololo, who then, I believe, occupied the country between the junction of the Kafue and Zambesi (the country now inhabited by the Maskolumwe). Later, Sibituane moved higher up into the Barotse valley, conquering the Barotse and also the Batoka of the river and its islands, and incorporating these tribes. Coming from the edge of the Kalahari, Sibituane's warriors naturally knew nothing of river life, but from the Batoka his young men soon learned to be good watermen and to manage canoes. Livingstone, who met Sibituane shortly before his death, says: "He was decidedly the best specimen of a native chief I ever met. I never felt so much affected by the loss of a black man before." Edward Cotton Oswell has also given in *With Livingstone in South Africa* (Badminton Library) a vivid picture of a midnight meeting with this chief. The next invasion took place under Mozilikatze, who had defected from the terrible Zulu chief Tschaka. He in his turn led his Zulus north, and met but was defeated by Sibituane. What elements this second expedition left behind it is hard to say, but at any rate we have seen that in the early part of the nineteenth century a new and sterner element had been engrafted on the original pastoral and river natives. And though in the average of size and stature the Batoka are inferior to the Zulus of the south and are very different in features from these, still I sometimes came across individual specimens who, both in size and cast of countenance, could not be distinguished from the typical Zulu. These individuals were also, I think, somewhat lighter in colour. I find that I also noted the fact that they did not have their front teeth removed, in the usual Batoka manner. Whether this means that they have treasured their lineal descent (only three or four generations, after all), the short time I spent among these people does not enable me to presume to say. But I ought to add that these exceptional specimens were only noticed among the men; all the girls and women I saw corresponded to the normal physique of the Batoka men; I never came across any who were at all comparable to the magnificent type of young woman so usual among the Zulus. Perhaps the one constant physical point in the men which struck one most was the great development of the dorsal muscles, the vertebral column, as in

a well-developed athlete, always lying in a deep furrow between the high ridges of the dorsal fascia. This is traceable in a great degree to paddling, but one also sees its commencement in quite small boys, due to the hard and sustained work (shared with the women) of pounding up millet seed for Kafir beer with the long and exceedingly heavy pestles of 'Mpane wood. Doubtless these people have been also affected, if only very slightly, by what one may call the farthest ripple of Dutch migration. I do not know whether or no there are actually any Dutch settlers among them higher up than Kazungula, but at any rate they have to a certain extent been commercially exploited by the Dutch. This probably explains their possession of rifles to which I have referred. Indeed I came across one Dutchman who had come up ostensibly to kill roan antelope and did kill two on the flats known as Cassaia. I was told later that he was "wanted" for gun-running with the Hereros.

These natives, speaking generally, did not strike me as being a fighting and scarcely as a hunting people, but rather as devoted to the gentler occupations of life. They are guardians of cattle. King Lewanika's cattle are distributed among his subjects, and round every kraal are cattle feeding in the bush. The natives cultivate maize and millet, and take fish with nets and spears. These nets are large, and are beautifully made. Those which I examined were netted from fibre-made string, as also were their fishing lines; I was told it was the fibre of a palm. The various things which I obtained were fastened with this string, and my carriers commonly used it; indeed I was surprised to find how little ordinary hempen string seemed to be used; because usually under advance of civilisation string and thread are among the first things to pass into use among natives, replacing the sinew or fibre originally used.

Their fish-spears are marvels of clever workmanship, and are most skilfully handled. The spear-head is some fourteen inches long, is four-sided, and tapers to a point. Down each of the four edges are set little barbs pointing backwards. These are so finely made that their exact construction cannot be clearly determined without a magnifying glass. They are then seen to be not separately attached but, on the contrary, cut out in the solid metal of the spear-head. The haft is a light, thin handle about fifteen feet long. This weapon lies commonly by the side of the steersman who stands in the bows of the boat, and it is picked up and thrown by him with remarkable celerity and precision. It never actually leaves the hand. The method of using it is as follows. The spear is lightly grasped just behind the head, and when launched the whole shaft runs down through the relaxed fingers and is re-grasped at the very end just as it seems to be leaving the hand altogether. Yet there is no button or other stop at the end of the handle. When one considers that allowance has always to be made not only for refraction of light but also for the movement of the boat, the dexterity necessary for fish-spearing will be apparent. The Batoka also make excellent axes, leaf-bladed assegais, and hoes. They obtain the iron from clay-ironstone and smelt and work it themselves. They are also very clever at pottery, and can turn out a large and deep bowl of thin ware as

accurately and well as any skilled potter in Europe. This pottery is first fashioned by the women's fingers and is then finished off, not on a wheel but on a disc revolved by means of a bowstring. The clay for their pottery they obtain from the big "ant-heaps" (properly termite-heaps), the "ants" having converted the original *humus* into a porcelain clay. Litia himself is a clever worker in ivory. I possess a pair of the royal ivory armlets kindly given me by himself, which, though I was assured they were made with a knife, are as true and symmetrical as if worked on a lathe. Even an ordinary dug-out canoe is a vessel that requires some skill in the making; and speaking of canoes, I may mention that, long disused, there lies on the sands at Kazungula what I suppose is one of the last, if not the last, of the old war canoes of the Zambesi. It would have held perhaps fifty or sixty (?) warriors. If my conjecture be correct, it would certainly seem that this boat should be moved and preserved in one of the public collections. I have a photograph of the boat, which is coloured in brown stripes on the outside and must have been fashioned from a very fine tree.

Like all the African natives, the Batoka are very fond of singing and dancing. Besides their big drums, they have musical instruments. One of these consists of a row of metal keys vibrated by the finger and resounding on a gourd. It is tuned by lengthening or shortening the free ends of these keys; and, although I could not myself detect much relationship between the notes, a musical composer who has carefully examined it assures me it is tuned on a recognisable principle. My own is an exceptional instrument, because it is the only one out of many I saw in which the "sounding-board" is made of wood; and it is an interesting point, and one that obeys the usual law of evolution of art, that, when carving out the wood, the maker has been at great pains exactly to imitate a gourd, even down to the thickened point where the stalk would have been attached.

These natives seemed to me to be not only most intelligent, but as more thoughtful (or perhaps I should say, more logical in their ways of thought), as far less childishly irresponsible than any "niggers" I had known before. Certainly they are delightful people, and, thrown absolutely alone with them as I was, it is of course possible I was too favourably impressed. They invariably evinced an instinct of courtesy and respect which was to me quite unexpected. It showed itself in a hundred ways, in many small things difficult to instance. When I was bathing, for example, my five and twenty men invariably withdrew quite out of sight and waited patiently till I rejoined them. I did not ask them to do this, it was of course a matter of absolute indifference to me; but there it was, and, remembering the discomfort I had suffered even in some European countries from the aggressive curiosity of the people, I was proportionately grateful to these poor fellows. They never touched a thing of mine without permission, they never sat and stared at one, and when I was inside a kraal, which without any directions they had emptied, cleaned, and assigned to me, they never so much as looked in at the doorway. No doubt if they had charge of a traveller who treated them in an offhand, a contemptuous, a familiar,

or a bullying manner, their own behaviour would also change. And this brings me to a point I am making for, viz., that under careful management they are capable of becoming useful and valuable citizens. It seems to me so great a pity that they should be spoilt by contact with our civilisation, which, judging from analogy, is the fate in store for them.

Let me give just one very small and simple instance which goes to show that they are endowed with an intelligence which is capable of being directed. The Barotse Police had its own "regimental" band which performed a selection of music before the members of the British Association. It was, of course, a curious performance, but only the more interesting on that account. The musical *rhythm* was wanting, and the familiar tunes sounded weird without it, but still the time was there, the melody was there, the harmony was there. If we realise what even this achievement means, what it means to have learned to play in harmony music entirely out of their range of comprehension (to them indeed it was not music at all), to have been able to concentrate their minds upon such a task, we shall, I think, be prepared to grant them an intelligence which could be usefully trained in many ways.

It seems to me a thousand pities that, before this Rhodesian township starts, they cannot somehow be combined into communities and trained along certain definite lines.

I am of opinion that a first and most wise measure would be the forbidding these natives to wear European dress. The dictum that "the Kafir puts on the white man's vices with the white man's clothes," is no doubt very true. I remember being told by the distinguished principal of a missionary college that when any of his natives had been away to the town, they were obliged before re-entering his precincts to remove their European clothes. But this sane and practical view is far from being shared by the ordinary missionary, who is convinced that dress is the beginning of Christianity, whereas experience might show him that too often it is the first step in degeneration. It would be a wise, if practicable, measure to forbid natives to wear European dress even in the town—I think especially in the town. Of course the literally naked Kafir tribes would have then to wear the loin cloth and "sampan" (I forget the native name for this kilt), a perfectly decent native dress. Politically also such a law would have a beneficial and far-reaching effect.

One word as to climate. When I was there the climate was delightful, and I was assured it was always so excepting in the rains. This is only what one would expect in that high dry plateau. One day with the thermometer at 99° Fahr. in the shade, I walked down from Kazungula to Livingstone (25 miles?) and was not distressed in the smallest degree. But one can there within the space of a few yards test the difference between a dry and a damp climate; for no sooner does one step into the damp area affected by the mist of the Falls than one is quickly "reduced to a rag."

The inhabitants of the future township are to be congratulated on the beauty of their playground. Upon myself the spell of the High

Zambesi was insistent and enduring. Even where the scenery was dull there was still the charm of wild animal life—the green-eyed crocodiles, the primæval hippos, the plain with its antelopes and zebras and its beautiful crowned cranes. The sandbanks were covered by regiments of birds, ibises, cranes, open-billed storks, spur-winged plover, sand grouse, scissor-bills, and many more. When we passed a forest patch at dawn, monkeys sat shivering in the first sunbeams, splendid fish-eagles stood sentinel upon the tallest trees, and otters chased one another about the island rocks. And when the hot day was gone, what could be more enchanting than to drop in silence down the river when bitterns were booming in the reeds, mysterious wings moved by in the shadows, and fireflies went and came like fairy lamps!

A NEW SCOTTISH EXPEDITION TO THE SOUTH POLAR REGIONS.

By William S. Bruce, LL.D., F.R.S.E.

With the publication of the first of the serial scientific volumes of the voyage of the *Scotia*, and with other volumes rapidly nearing completion, one comes in view of the end of the work of the Scottish National Antarctic Expedition. It may, therefore, not be out of place to make a general statement of certain plans that I have been maturing with a view of following up the work of the *Scotia* by means of another Scottish Expedition to the Antarctic Regions, which I am prepared to organise as soon as the necessary funds are provided.

The plan of the new expedition is similar to that of the recent Scottish Expedition, and is as follows.

There would be one ship of about 250 to 300 tons register, carrying about thirty-six men, including six men of science. The vessel would be provided with all the most modern oceanographical equipment and prepared to work in depths exceeding 3000 fathoms. The definite area selected is the region south of 40° S. in the South Atlantic Ocean, avoiding the tracks of the Scottish National Antarctic Expedition in 1902-04, but complementing and supplementing the *Scotia* explorations in those seas. A suitable base to commence operations is Buenos Aires. A start from there would be made in the early spring, say not later than August 1st, and a zigzag course under sail steered between latitudes 40° S. and 55° S.—a visit to Gough Island and the other islands of the Tristan d'Acunha Group is included—a double or treble line of soundings with a regular series of physical observations at each station would be made, and the trawl lowered two or three times every week. No haste is required on this voyage, the vessel will be going before westerly winds under sail the whole time, coal being husbanded for handling the vessel during sounding, trawling, etc. Cape Town would be the first port of call, and thus a belt of 1000

miles in width and over 3500 miles in length will be explored where no oceanographical work has been done at all, with the exception of some soundings and trawlings made by the *Scotia* in 1904. Whilst crossing the "Scotia Rise" which the Scottish Expedition discovered as an extension of the Mid-Atlantic Rise 1000 miles further to the south, it will be interesting and important to obtain by grippers samples of the rocks *in situ* of which this rise is built up.

At Cape Town it is intended to send all the scientific material and the first copy of the scientific logs home, in case of accident to the ship in her second voyage. The ship and all her gear being thoroughly overhauled, she would be filled up with coal and provisions. The South Sandwich Group is the next objective, and here an arrangement will be made for a vessel with coal and fresh food to meet her. The special interest in this region is to carry on bathymetrical survey, because opinion is divided as to whether deep or relatively shallow water exists where the isobaths are cautiously marked in the Scottish chart, namely that region lying between the south end of the "Scotia Rise" and the South Sandwich Group. This is of vital importance in the study of continental connections.

A short time would be spent at the South Sandwich Group, especially with a view of obtaining a knowledge of the geology and natural history of the islands. Having filled up with coal, a cruise eastward to Bouvet Island would be made to determine more definitely whether or no there is a "rise connection" between the Sandwich Group and that island, as well as with the south end of the "Scotia Rise." From Bouvet Island a southerly course should be steered towards the southern boundary of the Biscoe Sea and a junction made between the *Valdivia* and *Scotia* bathymetrical surveys. To join up the coastline between Cape Ann and Coats Land would be an objective, as well as to explore the coast westward of Coats Land towards Graham's Land, and thus to clear up the disputed land reported by Morrel and suspected by Ross, strong indication for the existence of which is given in the meteorological and bathymetrical results of the *Scotia*.

In March it will be necessary to decide whether the expedition is to winter in the south, but under no circumstances, if it can possibly be avoided, shall the ship winter. She is there for oceanographical research, and must not be turned into a harbour hulk. Accidents will happen, and she may be beset and forced to winter as the *Scotia* was, for which she will be thoroughly prepared. But if there is a wintering, it will if possible be by a party of about half a dozen men in a house on shore.

This project for Antarctic exploration does not lend itself in the least to the attainment of a high latitude. It is almost certain in fact that the ship would not pass the 75th parallel of latitude, and it is more than probable that it would pass little beyond 70° S., but there is no doubt that, for systematic, serious scientific work, this would be one of the most profitable forms of Antarctic exploration that we could undertake.

In the Biscoe Sea, the coastline of Antarctica will probably be

found to lie somewhere between 70° and 75° S. and to run in a more or less east and west direction, and if a winter station is set up it would be along this coast. After finding suitable anchorage, a house will be set up with a complete establishment for meteorology, magnetism, biology and other scientific investigations, and the party will make inland excursions. Should there be sufficient funds, it would be well to have a second ship for the express purpose of carrying an extra supply of stores and a house rather than lumber up the oceanographical ship with all this material, but it will be necessary of course to suit arrangements according to the funds in hand. Should the lie of the land be found to be as we suspect, a serious attempt will be made to cross the Antarctic Continent and to emerge somewhere along the coast of the Ross Sea, the journey being made along the meridian of Greenwich on the Atlantic side and continuing along the 180th meridian on the Pacific side. Such a journey will actually be of more intrinsic value than a journey towards the South Pole and back. It will give us a complete sectional idea of the Continent of Antarctica, and the expedition would never be covering the same ground a second time. This is a big project, and one would have to face the chances of failure, but it ought to be attempted. Lieutenant Shackleton has wisely led the way by actually trying motor power, which I for one have been advocating for many years. The Scottish Expedition would also use this mode of traction for the accomplishment of such a journey.

This region offers an especially fine field for meteorological and magnetical research, because of the systematised series of meteorological stations which exist to the north-westward of the region right up to the South American Continent—thanks to the efforts of the *Scotia* and of the energetic Argentine Republic that has continued the work of that Expedition.

To carry out these plans, which extend over fully two years, in a satisfactory manner, I shall require a sum of about £40,000.

THE PULSE OF ASIA: A REVIEW.[1]

THE first part of the title of this book, *The Pulse of Asia*, is somewhat in the style of the sensational novel, and is enigmatic, not at once to be understood by the uninitiated. The second part of it, however, indicates that the book is a serious scientific treatise; and it is amplified in the opening sentence of the author's preface. He there explains that the "book is the record of a journey in Central Asia, and its aim is to illustrate the geographic relation between physical environment and

[1] *The Pulse of Asia: A Journey in Central Asia illustrating the Geographic Basis of History.* By Ellsworth Huntington. Illustrated. London: Archibald Constable and Company, Ltd. Boston and New York: Houghton, Mifflin and Company, 1907. *Price* 14*s. net.*

man, and between changes of climate and history." In other words, the book sets forth the course and product of the author's investigation into and observation of the present physical features and contents of the regions visited and his conclusions from them as to the facts of the past; and it applies them specially to illustrate the two "hypotheses," (1) that physical environment in any given region materially affects its human inhabitants physically, mentally, morally, and socially; and (2) that in the past the known movement and action of mankind—that which is the subject of his history—have been more or less influenced by climatic change in regions of human habitation.

The hypotheses are by no means new. Nor has the author been the first observer and describer of the physical features and contents of those regions. Many explorers and travellers, as the list of references prefixed to the book shows, have visited and described them. In quite recent years Sven Hedin and Stein have done so in a way to leave little room for fresh geographical discovery of importance. What is in a measure new is the induction from the observed and investigated facts that the climate of those regions, so far as it depends upon natural water supply, has varied within historic as well as prehistoric times, and the application of these facts in illustration of the two aforesaid hypotheses.

Before proceeding with the record of his journey the author in an introductory chapter of sixteen pages expounds his views on the nature and functions of geography, more particularly with reference to Central Asia. These views, he explains, are derived from the teaching of Professor W. M. Davis of Harvard University, whom, in his dedication of the book, he designates "First of modern geographers"; and it may be worth while briefly to consider them.

According to the old definition, which follows etymology, geography is the describing of the earth's surface, its form and physical features, its natural and political divisions, and the climate, productions, flora, fauna, population, etc., of these divisions. In this sense it is perhaps more an art than a science, and its province is rather the description of things as seen by the explorer and observer than inquiry into their causes and effects.

To the author of this book geography thus considered is "an empirical science." But it has of late years been transformed into "a rational science" by being linked in one group with anthropology, history, and sociology—"a group possessing, by means of geography, a unity as great as that of the biological sciences, botany, zoology, and physiology," whose bond of connection and common key is the hypothesis of evolution. Geography must still take cognisance of "the *distribution* of organic and inorganic forms in space," but its more exalted and extensive sphere is to deal with "the *relation*, both direct and indirect, of the entire group of organic forms inhabiting any part of the earth's surface to the inorganic forms in the same region." "Geography, in the new view," the author goes on to say, "tells us not only what forms of plants and animals live together in mutual dependence, but also why the human inhabitants of a given region possess certain habits, occupa-

tions, and mental and moral characteristics, and why they have adopted a certain form of social organisation." He adds that the recognition of the relation of inorganic causes to organic results is universal among primitive people. It has been suspended among civilised people, but is now to be restored through the reconstitution of the science of geography.

All this seems tantamount to saying that the business of the geographer is not only to describe the features and contents of the earth's surface, but to study, and to make inductions from the study of the action and re-action upon each other of the various sets of phenomena described. The ideal new geographer is, in short, to be a student, if not a master, of all the sciences to which the old-fashioned geographer has acted as a purveyor of facts; and there is to be attached to geography a large part of the domain of those sciences, more especially in respect to their origins and development. In exemplification we may take Chapter v. of this book, "The Kirghiz Nomads and the Influence of the High Plateaus." It is in fact a very admirable study in sociology, and the author in treating the subject as he has done, is a sociologist, although he calls himself a geographer and has inserted the essay in what purports to be a geographical work. In like manner, in Chapter xviii., "The Geographic Basis of History," wherein, like Gibbon, he treats of the influence of climatic conditions on history, he has in fact slipped into the rôle of historian and out of that of meteorologist. In a university of learning and science it would surely be the duty rather of the Professor of History to summarise geographical facts and interpret their historical significance than of the Lecturer on Geography to expatiate and philosophise on history. After all, and notwithstanding parade of word and argument, what is proposed is not so much the opening up of a new field of science as the transfer of subject-matter from one department or heading to another. The general result of the new departure, if proceeded with to extremes, may be a good deal of scientific overlapping. As regards geography, the probable result will be the division of the science into a number of branches with their own specialists, and the partial supersession of the old-fashioned "empirical" geographer by a host of "rational" geographers recruited from other sciences.

While the author did not allow to pass unutilised any opportunity of observing the influence of physical environment upon animate nature, and chiefly upon mankind, both in the earlier part of his journey across Kashmir, Ladak, and the Karakoram, and later in Central Asia, the most important research undertaken by him was into the past and present climatic conditions of Chinese Turkestan—the Tarim, or, as he prefers to call it, the Lob, Basin. The methods of this investigation and its results are minutely and graphically detailed in the book before us. It is in truth the very full and well-written record of a splendid bit of scientific investigation. Here it is not possible to do more than outline the conclusion arrived at and the grounds for it. The conclusion is that before and about two thousand years ago the Lob Basin was more humid than it is now; and that between then and

now there have been two main periods of increased aridity. One of these occurred in the interval between the second or third and the ninth centuries of our era. It was followed by a humid cycle from the ninth to the sixteenth century. Thereafter the climate relapsed into the arid and desert conditions which still prevail.

The hydrology of the Lob Basin and the changes in the distribution and state of its land and water, with the consequent expansion, contraction and shifting of population and cultivation, have been amply described by previous investigators. Both Sven Hedin and Stein have endeavoured (as readers of this *Magazine* know) to explain these changes as mainly due to the operation of wind and water forces, uniformly at work now, as in the past. The suggestion that there has been a change towards greater dryness of climate within historic times has been made. But as a well-founded hypothesis explanatory of the natural and artificial features of the floor and lower edges of the Lob Basin within the historic period, that proposition, augmented by the hypothesis of alternations (or, as the author would say, "pulsations") of climate, has been formally put forward now, apparently for the first time. The evidence in support of it is mainly what may be called circumstantial. It is derived chiefly from an examination of the physical features, past and present, of the region, and of the archæological remains discovered within it; from references contained in scanty historical and other written material, dating from periods more or less remote, and found in or relating to the region; from the analogy of other tracts, now dry and desert, but once fertile and populous, which also are situated in Western Asia, namely Iran and the Caspian region; from the influx of peoples, presumably Asiatic and from the East, and in search of food and comfort, into Europe during the centuries which were signalised by the overthrow of the Roman Empire and the general unsettlement of the European populations. Of what may be described as direct evidence, the record of local observations *ad hoc*, there is little or none; nor is any such now attainable, seeing that scientific observations of that sort in those regions date only from the advent of the modern traveller. But the geologist and meteorologist have established, or are in process of establishing, the occurrence of periodic cycles of climatic change on our planet. To such meteorological pulsations mainly our author attributes the waxing and waning of aqueous precipitation and evaporation which have in great measure ruled and moulded the history of Central Asia and its inhabitants during the last two millenniums. The author's conclusions, if not judicially proved, will probably be accepted as a well-sustained and reasonable contribution towards the solution of the Central Asian mystery, which probably Sven Hedin and Stein and other explorers admit has not hitherto been exhaustively explained.

Regarding the generalisations to the illustration of which the author has devoted the material of his researches, and which have been stated above, more need not be said. The reader will find them referred to again and again in the course of the book, and they are finally enunciated with much point and force in its closing chapter. They are generally accepted propositions with the biologist, sociologist, and

historian, to whose provinces they belong rather than to the geographer's and by whom, as well (notwithstanding the author's dictum) as by "the average man of civilised people," they have long been recognised and taken into account.

GEOGRAPHICAL NOTES.

Europe.

River Capture in the Appleby District.—In the *Proceedings* of the Geologists' Association (xx. 3), Dr. Marr gives a very interesting account of the geology of the Appleby district, Westmorland, which is a picturesque area of low ground lying between the Pennine scarp to the east and the high ground of the Lake District to the west. The special importance of the paper to geographers, however, is the account which it gives of the development of the river systems here. At the time of the Pennine uplift the eastern slope was much less steep than the western, and one consequence is that the western rivers have much more erosive power than the eastern, and have thus cut back the watershed, capturing the headwaters of the eastern streams. For example, at the geologically interesting High Cup Gill the Eden is now engaged in capturing tributaries of the Tees. The former river, up to Kirkby Stephen, runs in the soft New Red Sandstone, which erodes so readily that the village named, which is only seven miles from the river-head, is less than 600 feet above sea-level—a fact which gives its upper tributaries a relatively very great velocity. The adjoining rivers, the Tees, Swale, Lune and Ure, run for many miles over much harder rocks, and the consequence is that the 600 feet contour-line crosses them much further down their course. Their upper tributaries have thus not the velocity of those of the Eden, and this has again helped the last-named to capture their headwaters. In detail Dr. Marr gives some pretty examples of this capturing process, especially one in the Ravenstonedale valley.

Africa.

The Water-Parting in NW. Africa.—In the *Bulletin Trimestriel de la Société de Géographie et d'Archéologie d'Oran* for October last, M. A. Joly discusses the question of the real line of division between the marine and continental streams of Morocco, Algeria and Tunis. It is usually believed that the Tell forms the water-parting, except in the case of the Sheliff and its tributaries, which form an exception to this rule. The object of the paper is to show that on the other hand the Sheliff represents in reality merely an advanced stage of a process which is going on throughout the area, by means of which the ocean-flowing streams are cutting back their heads and capturing the affluents of the continental wadis. The existing Sheliff, the author believes, is made

up of two separate river-courses, united in the ravined district near Boghar, where the present stream cuts through between the cliffs of Titteri and the hills of Boghar. Formerly the upper Sheliff flowed into a system of lakes of which the Daias of Bu-Guezzul are the remnant, while the lower Sheliff drained the northern slopes of the Tell. The ocean-flowing stream cut back through the mountain barrier, and captured the stream which now forms the upper Sheliff. In a similar fashion the Isser of Kabylia has captured one of the affluents of the Hodna.

The author's conclusion then is that the watershed in NW. Africa does not coincide with the crest of the Tell Atlas, but often extends a considerable distance into the interior of the continent, in the case of the Sheliff even so far as the Saharan Atlas. This phenomenon is, however, of geologically recent origin, and is due to capture and erosion on the part of the streams entering the Mediterranean.

The Dunes of the Western Coast of Morocco.—In *La Géographie* for December 15, M. R. Chudeau gives an interesting critical analysis of a recent paper by M. Pobéguin on this subject. In the first place the dunes show some interesting contrasts with the more familiar type as represented in the *Landes* of France. There the sand comes from a distance, and is apparently inexhaustible in amount. The dominant winds are westerly, *i.e.* perpendicular to the coast, and every grain carried by the wind thus becomes a permanent part of the land. In Morocco the coast is bordered by cliffs of soft grit, which are constantly breaking down under the influence of the waves to form sand—so that the dunes are formed at the expense of the waste of the adjacent land. Again, the sand is only transported in the dry season, and the winds are then northerly, *i.e.* blow parallel to the coast. The result is that the dunes have no tendency to travel inwards. They form a peripheral band, of a width of several kilometres. Each massif has the form of a triangle, whose apex is turned to the north and lies some distance from the left bank of a wady, while the base rests usually on the right bank of a more southerly wady. This base contains the highest dunes. In some instances the base of the triangle is determined by a bend of the coast, instead of by a wady. Where a wady forms the southern boundary, its bed is encroached upon by the sand in the dry season; when the floods come, however, this sand is swept out to sea to recommence the cycle in the next dry season. The two banks of the wady are, however, affected differently. The right bank is, it is true, violently eroded in the flood season, but in the dry season it experiences a marked increase under the influence of the north wind and a coastal current from the north. The left bank, which is composed of harder material, is less eroded, but then it has no means of making up for the waste. The result is that the mouth of the wady is always tending to be displaced towards the south. The village is placed on the left bank to avoid the drifting sand, and in consequence on this western coast of Morocco, streams, dunes, and villages slowly migrate southward.

Still another cycle exists. As the grits decompose to form sand, so the sand re-forms grit. The innermost dunes during the dry season

become fixed by means of a calcareous crust which forms at their summit. The exact mechanism of causation is a little obscure, though the broad facts are clear. In the rainy season the water, charged with carbonic acid, takes up lime which is subsequently re-deposited. In this part of Morocco, however, the air is almost constantly saturated, so that it is not clear at first sight what becomes of the surplus carbonic acid, *i.e.* how the soluble bicarbonate is reduced to the condition of a carbonate. M. Chudeau ascribes this to the action of minute plants, while M. Pobéguin thinks that the fixation is due to the action of running water, whose action through the permeable dunes is not quite easy to understand, for the calcareous crust forms at the summit.

The dunes of Morocco reach a considerable height; thus one near Mogador measured 116 metres in 1905. It is true that in the Sahara heights of up to 500 metres have been measured, but in this case the sand is piled up upon hills or plateaux, *i.e.* the dunes are not composed entirely of sand. M. Pobéguin believes that this is the case with the dunes of Morocco, between which lie passages composed of perfectly smooth clay, but he does not make clear what in his opinion is the cause of the accumulation of sand, which must be stopped in its course by some natural obstacle.

Polar.

The Glaciation of the Antarctic.—In *La Géographie* for December 15, M. Charles Rabot gives a very interesting summary of the facts in regard to the glaciation of the Antarctic which have been brought out by the various recent expeditions. He gives it as his opinion that the two most important generalisations which result from the recent expeditions are, first, the unique character of the Antarctic ice as compared with the more familiar Arctic type. The most frequent Antarctic type, it appears, is that of enormous sheets of ice—of glacier ice—which covers hundreds of kilometres of area, and which is attached on the one hand to the inland ice, and on the other floats on the surface of the sea. Sometimes, as in the region of the Great Barrier, these ice-sheets fill up great arms of the sea, while at other times, as in King Oscar Land and Emperor William Land, they merely jut out into the ocean. Nothing comparable has been observed in the Arctic, but on the other hand such ice-sheets probably existed in Europe during the Ice Age, and it is possible that a part of the Baltic was then occupied by an ice-mass ending in a Great Barrier. The second point is that the recent expeditions observed a general retreat of the ice in the Antarctic, and all ascribe it to the same cause, the frequence and violence of the winter hurricanes, which sweep away the snow. A similar phenomenon has been observed in Spitsbergen, and the deduction is that the period of maximum glaciation must have been a period when the climate was less stormy than at present. If, however, all observers are agreed on this point, they differ greatly in their opinions as to the cause of the change. As an exception to the general rule of stormy winters and diminishing glaciation, the Charcot expedition found in Wandel Island

a régime of winter calms, associated with excessive glaciation. It would appear indeed that at the present time the most highly glaciated area of the Antarctic is to be found in the Palmer Archipelago and the neighbouring islands which fringe this part of the Antarctic continent. Even this brief summary, however, may serve to show how many problems still await solution in the Antarctic area.

The British Antarctic Expedition.—The *Nimrod* returned to New Zealand at the beginning of March, having experienced very stormy weather during her cruise. It was found impossible to land Lieutenant Shackleton or his party on Edward VII. Land as was hoped, but a successful landing was effected near the *Discovery's* former winter quarters on the shores of M'Murdo Sound, and a base camp has been established at the foot of Mt. Erebus, on Cape Royds.

Meteorology in the Antarctic.—Dr. W. S. Bruce has received word that the *Uruguay* has returned from Scotia Bay, South Orkneys, bringing with her the party from the Meteorological Station on that island, and having left behind the relief party to continue the work for another year. This relief party was on the *Austral*, which was wrecked (cf. p. 102), but the party was immediately transferred to the *Uruguay*, which accomplished the journey in safety.

General.

Glacial and Fluvial Erosion.—In vol. i. of the new annual *Revue de Géographie*, there appears a very interesting article on this subject by Professor Brunhes, all the more interesting because it begins by a discussion of Professor Davis's article on "The Sculpture of Mountains by Glaciers" which appeared here in February 1906. Professor Brunhes reproduces the three figures which illustrate that article, and grants the essential differences between valleys which have been subjected only to fluvial erosion, and those recently occupied by glaciers, but is not disposed to agree with Professor Davis that the whole of the differences between the two valley types is to be ascribed to the differences between glacial and stream erosion. The subject has been so frequently discussed here that it is only necessary to recall the fact that recently glaciated valleys are U-shaped, not V-shaped like most river valleys, and display, relatively to the side valleys, the phenomenon of over-deepening (*Übertiefung* of the Germans, *surcreusement* of French geographers). The problem then which is still being so keenly debated is—what agent except ice could produce these peculiarities? Professor Brunhes' article is of some length and is copiously illustrated; we cannot summarise here all his lines of reasoning. The point of most outstanding interest is, however, the following. A number of large, recently-glaciated valleys show as a very striking feature the presence of a "bar" of rock across the valley. Every one who knows the Alps could give examples of this, the mass of the Kirchet in the valley of the Aar at Meiringen is a good example; in

the Upper Engadine, in the valley of the Inn, more than one such rock bar occurs. Again, at the extremity of many of the existing glaciers of the Alps one may see that the snout is divided into two parts by a central boss of rock—the boss at the extremity of the Upper Grindelwald glacier is familiar to most people. So common is this in Switzerland that the Swiss peasants have a special name—Platten—for these bare portions of rock. The bars already mentioned are normally saddle-shaped, arched in the centre and depressed at the sides. Again, it is not infrequent to find in the large glacial valleys curious islands of rock, sometimes still linked to the valley wall by a remnant of a rock-bar, while at other times later deposits have covered up this bar. All these are obviously phenomena of the same order. It may further be noticed that very frequently a double torrent emerges from the snout of a glacier, one coming from each side. These two torrents are obviously responsible for the two lateral depressions to be seen at either side of the arched centre of the bar, or for the formation of the island in the extreme case. It is the presence of this double torrent, according to Professor Brunhes, which is responsible for the U-shape of the valleys and the overdeepening. In the rare cases where there is only a single glacial torrent, the valley tends to become V-shaped, like an ordinary river valley. What part does then the ice play? First as to the wall of the valley, the ice assists in maintaining the cañon-like wall, with its characteristic steep slope, by carrying away the rock-waste, instead of leaving this to check erosion. The effect is much the same as with marine cliffs, the attack and process of demolition being carried on at the base, and the waste constantly removed, so that there is no protective slope of débris. Further, the ice modifies markedly the effect of stream erosion, especially in the centre; it smoothes and planes the central mass, undermined by the lateral streams, it carries its constituent rock away piece by piece and sometimes succeeds in removing it altogether, leaving only remnants of "bars" or islands, to mark its former position. In brief, the U-shaped valley is the result of the action of the two (or sometimes more) glacial streams, which run approximately parallel to the sides of the glacier. In other words "glacial" erosion, in Professor Brunhes' view, is largely the work of the sub-glacial torrents, but the peculiar effect of these torrents is due to the fact that they are *sub-glacial*, that is, that their activities are modified and determined by the presence of the ice.

Commercial Geography.

Railways in Nigeria.—The following is the present position of affairs with regard to the progress of the Nigerian railway system, one portion of which—namely, from the Niger to Kano, a distance of some 400 miles,—was recently sanctioned by the Secretary of State. (See vol. xxiii. p. 491.)

The line running from Lagos *via* Ibadan to the Niger, a section of 302 miles from the coast, has now entered Northern Nigeria, and at the present moment the railhead should be Ilorin, 227 miles from

the sea. A regular service is running from Lagos into the interior for a distance of 186 miles to Oshogbo. In connection with the section from Ilorin to Jebba and the portion of the extension from the Niger to Zungeru, railway construction parties have been despatched ahead of the present terminus, and are working in two parties on either side of the Niger. At the present rate of progress there should be direct rail communication between Lagos and the Niger in the course of the present year. The 60 miles section between Ilorin and the Niger presents many difficulties, involving as it does the construction of heavy rock cuttings.

Beyond the Niger the main line will proceed *via* Zungeru and Zaria to Kano, while another section of about 150 miles starting from Baro, a point on the Niger 123 miles south of Jebba, which is open to vessels of suitable draught all the year round, will connect with the main line at some point between Zaria and Zungeru. For the present the Niger will be crossed by means of a steam train ferry, which is now being constructed in England and is expected to reach the Niger in August. This will be capable of transporting a whole train across the Niger without transhipment. It will ply between the Jebba station of the Lagos system and the station on the Kano line on the opposite bank of the river. This point of the Niger is probably the most suitable one for the construction of a bridge, and it is possible that at some future date the two Nigerian sections will be connected in this way. On the trans-Niger section, which is under the personal supervision of Sir Percy Girouard, the High Commissioner, very satisfactory progress is being made. The rails for the first 20 miles of the line have been landed, and thousands of natives are engaged upon the earthworks. The country on the first 150 miles of the line from Baro is said to be comparatively easy for engineering purposes.

In connection with the scheme for improving the bed of the Niger and facilitating navigation, an expert who has had experience on the Nile and the Mississippi will be despatched from England in the course of this spring in order to report upon the scheme proposed to the Imperial Government by Sir F. Lugard and Sir Percy Girouard for improving and deepening the waterway.

The Progress of New Zealand.—A recent Blue-book (cd. 3867) on British Trade with New Zealand gives the following details as to the population, statistics, amount of land under cultivation, etc., in those islands.

The Dominion of New Zealand, which extends over a territory which, inclusive of the small dependent islands in the Pacific Ocean, amounts to 104,531 square miles, or almost precisely twice the area of England and Wales, with an estimated population at the close of the year 1906 of 908,726 persons (exclusive of about 48,000 Maoris and some 12,000 inhabitants of the Cook and other Pacific Islands), is at present enjoying a period of rapid economic development and of great and general prosperity. The population has steadily advanced in numbers, at a somewhat increasing rate of progress; between 1895 and

1900 the increase was a little less than 10 per cent., and in the ensuing quinquennial period it was nearly 15 per cent., whilst the estimated actual growth in 1906 (26,264) was the largest yet recorded for any single year in the history of the colony since 1879. It is noteworthy that the part of the recent increase of population which has been due to immigration has been derived almost entirely from the United Kingdom and Australia.

The amount of land under cultivation was 8,462,495 acres in 1890, and 14,114,925 acres in 1905. The number of separately occupied and cultivated holdings of over one acre in extent rose from 38,083 in the former to 69,942 in the latter year; of this total 19,787 holdings were of 10 acres or less, 11,745 of 11 to 50 acres, 7562 of 51 to 100 acres, and 9950 of 101 to 200 acres, whilst only 4398 were of more than 1000 acres. Thus agriculture in one form or another is, and must long remain, the predominant interest of New Zealand, but at the same time industries have been established, and strenuous and persistent efforts are being made to develop them. The number of persons employed in "industrial enterprises" increased from 27,389 (including 2969 females) in 1896 to 49,806 (including 6253 females) ten years later, whilst the value of the output (including repairs) advanced in the same period from £9,549,360 to £22,422,736; and although, owing to certain changes in the Census definition of a "factory," the figures for the two years are not strictly comparable, they are sufficiently so to indicate the extent of New Zealand's industrial progress. Mining activity is confined chiefly to coal and gold. The output of the former rose from 637,397 tons in 1890 to 1,585,756 tons in 1905, and during the same period the export of gold produced in New Zealand, which, however, fluctuated considerably, rose from 187,641 ounces to 520,485 ounces—the advance since 1900 having been particularly marked. The total number of persons engaged in gold-mining in 1905 was 9362, and in coal-mining 3269.

EDUCATIONAL.

In vol. xxiii., p. 377, we gave some account here of a paper by M. Sorre on the Distribution of the Population of Lower Languedoc. M. Sorre has published a further paper in *Annales de Géographie* for November 15, in which he gives a very interesting account of the mode of grouping of the population and their habitations in the coastal region from Nîmes and Montpellier to Narbonne. Like the paper on Brittany discussed in our issue of January last (p. 41), the present paper may be recommended to the notice of teachers not only for its facts but for its methods—as an interesting study in human geography.

The paper as indicated above refers to the littoral plains in Lower Languedoc, a region which is interesting because practically only one plant is cultivated—the vine. The fisheries of the lagoons, and the collection of salt, form additional sources of wealth, but apart from these the population depends solely upon the vine. It was not, however,

always so: during the early part of last century wheat and other plants were cultivated, so that the recent history has been the replacement of polyculture by monoculture. The author proceeds to show how the distribution of the people and their particular type of dwelling are all directly related to the dominant cultural plant. Such a condition of affairs is practically unknown in this country, where rural life is always associated with a multiplicity of crops, and the teacher may find the conditions in the littoral of Lower Languedoc an interesting contrast to those which can be observed in this country.

Under the title of "Geographical Progress in England," M. A. Guillotel contributes to the *Revue de Géographie Annuelle*, 1, an interesting account of the present state of geographical teaching in England. In similar cases we are not unaccustomed to find that our neighbours refuse to recognise that the name *England* has so limited a connotation as we are in the habit of assigning to it, but unfortunately here it is England in the limited sense that is under consideration. In speaking of books and literature, of maps and atlases, the author gives Scotland her share of notice, but as regards the university teaching of geography there is nothing to be said meantime, though as all our readers know, the beginning of next autumn session will remove this reproach.

The paper begins with an account of geographical teaching at the English Universities, most space being naturally given to the Oxford School of Geography. This is followed by an interesting discussion on the views held as to the position and scope of geographical science in England, in the course of which the author gives it as his opinion that the English point of view has been very largely influenced by Professor Davis of Harvard. From the general trend of the discussion one gathers that the author's point of view is even more comprehensive than that generally adopted here, for he sums up by saying that geography investigates all the organic responses to the different physical environments. This discussion is followed by some notes on books, atlases and papers recently published in England and Scotland. Among the atlases a very high place is assigned to Mr. Bartholomew's "Survey Atlas of England and Wales," from whose accompanying text very extensive quotations are made. Among the papers mentioned or summarised we are gratified to note several which have appeared in this *Magazine*. As a summary account of the present state of geography in Great Britain by a very sympathetic observer, M. Guillotel's paper is worthy of special note.

A series of Geographical Excursions are now being carried on in connection with the Outlook Tower, conducted by the following gentlemen:—Messrs. Frank Spence, Alexander Horne, Archibald Milne, Frank Michie, and H. J. Findlay. The excursions, the first of which was held during March, will be continued through the spring and early summer, and will deal with physical geography and simple methods of map-making. They are held on Saturday afternoons, and the number of those participating is limited to twenty. Applications should be made to the Secretary, Outlook Tower, Castlehill.

NEW BOOKS.

EUROPE.

Dalmatia: The Land where East meets West. By Maud M. Holbach. London: John Lane, 1908. *Price* 5*s. net.*

It is a pity Mrs. Holbach did not make more of her opportunities. Our only fault with this little volume is that there is not enough of it. With evident artistic instinct, the authoress has not failed to note the chief beauties—natural and architectural—of the places visited, but with the exception of those of Spalato and Ragusa, her descriptions of places and peoples are tantalisingly meagre. No part of the Old World offers so rich a field to the archæologist, the antiquarian, and the artist as do the coasts and islands of Dalmatia, and Mrs. Holbach proves in her book that she is quite capable of elaborating the story of her trip had she been so minded. Notwithstanding its modest dimensions, however, this book ought to be invaluable to those who wish to know more about where "East meets West."

The photographs illustrating the book are above the average.

The Rhine: Its Valley and History. By H. J. Mackinder. With Illustrations in Colour after Mrs. James Jardine. London: Chatto and Windus, 1908. *Price* 20*s. net.*

No foreign river is so well known to British travellers as the Rhine. Our novelists, from Smollett and Thackeray to the present day, have made it the scene of innumerable British adventures, and in spite of its once picturesque banks having been converted by prosaic modern vine-growers into earthy patches, a charm hangs around the great river still. It has inspired many a peaceful *Lied*, but also two renowned national war songs, for while Rouget de l'Isle wrote the "Marseillaise" at Strassburg in 1792, the "Wacht am Rhein" appeared in 1854 and heralded the German victories of 1870.

Mr. Mackinder's statement that "the theory that the Rhine is the 'natural' frontier of France was bequeathed to Frenchmen by the Emperor Augustus" is subject to the rider that, although the Rhine may have been a boundary of Roman Gaul, it was only in comparatively modern times the boundary of France. After a general description of the Rhine the author considers the Rhaetic Rhine, the Swabian Rhine, the Aar, the Upper German Rhine, the Neckar, the Main, the Rheingau, the Moselle and the Upper Meuse, the Rhine Gorge, the Lower German Rhine, the Lower Meuse and the Scheldt, and the Delta. Surely never was a river so thoroughly examined by a competent physical geographer, nor ever more beautifully illustrated than by Mrs. Jardine, whose coloured pictures (such as that of the Lorelei) are as dainty as they are exact. One of her illustrations represents the statue of Sir Francis Drake at Offenburg, and one wonders to find the great sea-captain so far inland, but, according to Baedeker, he is celebrated there as the introducer of the potato into Europe!

As a geographical and historical description of the Rhine nothing could be better than this work, but one misses the lighter, literary aspects of the subject, and would have liked to have heard something of the great German poets who have sung of the river or wandered by its shores. The marvellous life of Goethe, for example, was largely spent on or near the Rhine. Heine immortalised its legends. Uhland and Rückert glorified its neighbourhood. To the German the

Rhine always meant more than a geographical term. He regarded it as a national possession, and in 1870 he permanently enforced his claim.

From a picturesque, dangerous, rock-barred, robber-haunted stream, the Rhine has been converted into a most important navigable and commercial waterway. "Though a mastless port," says Mr. Mackinder, "Mannheim, as measured by the tonnage of the wares handled, is now one of the great ports of Europe. Yet it is in the very heart of the Continent." As Germany, however, does not possess the lowest or Dutch portion of the Rhine, where it issues by several mouths into the sea, German goods coming down the Rhine for foreign export are subject to Dutch middlemen and Dutch duties. To obviate this, a great canal was not long ago projected to pass entirely through German territory from the Lower Rhine to the North Sea. The Rhine itself is, however, the natural trade route from its source to its estuary, and it is highly improbable that this route could be deflected. Besides, the enormous expense of constructing such a canal would entail charges perhaps heavier than the duties levied in Holland. The volume has several sketch-maps in the text, and is completed by two excellent orographic maps of the Basin of the Rhine.

The Geological Structure of the North-West Highlands of Scotland (Memoir of the Geological Survey of Great Britain). Edited by Sir ARCHIBALD GEIKIE. Map. H.M. Stationery Office. *Price* 10*s.* 6*d.* 1907.

The appearance of this long-expected memoir marks the conclusion of one of the most significant pieces of geological investigation which have ever been accomplished in this or any other land. In the quarter-century which has elapsed since Sir Archibald Geikie first announced the startling results of Messrs. Peach and Horne's preliminary survey of the Durness and Eriboll areas, the conclusions to which these acute observers were driven have become the common property of text-book writers in Britain. In other countries these conclusions were received with reserve and not a little incredulity, and the publication of official data has been awaited upon all hands with the keenest interest.

The history of the great Highlands controversy is discussed by Dr. Horne in Chapters I. and II. The salient points in this history are as follows. In 1854 C. W. Peach announced the discovery of a Cambro-Silurian fauna in the Durness limestone. In 1858-60 Murchison's pronouncements upon the succession of the old gneiss, the red sandstone, the fossiliferous quartzites and limestones, and the Eastern gneisses and schists were published; Murchison regarded the fossiliferous beds as of Lower Silurian age and the apparently conformable Eastern gneissose series as post-Lower Silurian. In spite of repeated attacks by Nicol and others this view was almost universally accepted and similar schistose rocks throughout Europe were correlated with these Eastern schists and mapped as altered Silurian strata. This view of the Highland succession was not finally relinquished until 1884, when the preliminary survey above referred to showed it to be untenable. The appearance of this latest memoir marks the fourth and concluding stage of the controversy. The fact is, that the structure of the NW. Highlands, instead of having the beautiful simplicity indicated by the Murchisonian doctrine, is of an almost unparalleled complexity. The apparent regular succession of Western Gneiss, Torridonian, Cambrian, and Eastern Gneiss by which Murchison and others were deceived is now known to be in reality due to a series of gigantic reversed faults of nearly horizontal hade—the "Thrust-Planes" of the Survey officers—by which great belts of the older rocks have been thrust over younger formations. This effect is further complicated by such an extraordinary number

of lesser foldings and faultings that the period of twenty or more years which has been required for the detailed mapping of the region does not seem excessive. As Sir Archibald Geikie wrote in 1884—"When a geologist finds vertical beds of gneiss overlying gently inclined sheets of fossiliferous quartzite, shale, and limestone, he may be excused if he begins to wonder whether he himself is not really standing on his head."

Besides the interest attaching to these amazing tectonic phenomena and the light which they throw upon the process of mountain-building in other regions, this memoir will be widely studied on account of its valuable contributions to our knowledge of the petrography of the ancient gneisses and schists and of the subject of dynamic and contact metamorphism.

In spite of the fact that it is the joint production of no less than six authors (Drs. Peach, Horne, and Teall, and Messrs. Gunn, Clough, and Hinxman), the book is characterised throughout by a masterly clearness of exposition such that, while satisfying the utmost requirements of the scientific reader, its matter will yet be quite within the comprehension of the student and the amateur.

As for the contents, so for the get-up of the volume we have nothing but unstinted praise. Its fifty-two beautiful plates include some of the finest geological photographs which we have ever seen, while the diagrams and sections are clear and numerous. The binding and printing are good, and typographical errors are conspicuous by their absence.

ASIA.

La Rivalité Anglo-Russe au XIX Siècle en Asie. Par Dr. Rouire. Paris: Armand Colin, 1908. *Prix* 3 *fr.* 50 *c.*

The Anglo-Russian Agreement of 30th August 1907 has been as roundly condemned, as it was amply defended, by very high authorities. Lord Curzon and Professor Vambéry were among its detractors, and Lords Cromer and Lansdowne among its advocates, while the present British Foreign Secretary, Sir Edward Grey, supported it in a great speech which the *Spectator* declared proved that "the Agreement must relieve India of one of the heaviest of her burdens, and prepare the way for arrangements which, of all others, may render the peace of Europe continuous and stable. The *entente* with Russia is, in fact, as valuable as that with France."

A Frenchman like Dr. Rouire would naturally approve of an Agreement so satisfactory as this one is to Russia, the ally of France; but, in this volume, he gives his reasons for believing that the Agreement does justice to both the contracting parties. He points out that, previous to its negotiation, "the influence of Russia dominated the north, and British commerce the south, of Persia." He admits that the Agreement "gives to Russia the lion's share of Persia," but he considers that Britain is compensated by receiving, equally with Russia, the supervision of Persian affairs and acknowledgment of her special interests in the Persian Gulf. Besides, Russia renounces all political action in Teheran, recognises the principle of commercial equality and equal control of Persian finances, and foreshadows the eventuality of an Anglo-Russian *condominium*. In giving up to Britain the port of Bandar Abbas, which commands the Straits of Ormuz and the entrance to the Persian Gulf, Russia deprives herself of egress from the Gulf and renounces her dream of access to the sea and a warm-water port. Thereby Britain acquires influence on both shores of the Gulf up to the estuary of the Euphrates.

The author, however, points out that, on the western, or Arabian, side of the Persian Gulf, Britain cannot control Muscat and the Sultanate of Oman without

the consent of France, the Anglo-French Convention of 1862 being still in force and assuring the independence of Oman. Further north the republic of Koweit has allied itself with the Indian Government, although its suzerain is the Sultan of Turkey. A railway has been spoken of between Koweit and Port Said, while the railway from Baghdad will terminate at Koweit, which, says the author, "will be, some years hence, the port of transit between India and Europe. In the hands of the British, Koweit will be the key to the new route to India, just as Alexandria and the Cape are, in their hands, the keys to maritime routes. Whoever possesses Koweit will be master of the terminus of the future trans-continental routes to India—that down the Euphrates valley and the other across Arabia—and it would evidently be for the interest of the rulers of India that they should possess Koweit."

Dr. Rouire does not mention the railway which, according to Lieut. A. T. Wilson (*Geographical Journal*, February 1908) might be easily and profitably made from Bandar Abbas to Shiraz, a distance of some three hundred miles within the neutral sphere of influence.

AFRICA.

A Woman's Pleasure Trip in Somaliland. By Frances Swayne. Bristol: John Wright and Co. London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1907. *Price* 4*s. net.*

Miss Swayne in this little volume gives us a charmingly fresh and interesting account of a three months' holiday, which she spent with her cousin, the Commissioner of Somaliland, in the winter of 1905-6. The authoress expressly disclaims any thought of being instructive, and confesses she has no thrilling adventures to relate either of man or beast; but it is clear that she had a very enjoyable time, for the most part in camp high up in the Golis range of mountains. Of course being with the Commissioner, she saw the country under the most favourable circumstances, and she naturally depicts the Somalis and camp life with sincere enthusiasm and frank admiration. She evidently believes that there are great possibilities in the future for Somaliland as a health resort and winter residence, especially when people get tired of Cairo and the Nile. Miss Swayne has embellished her book with a profusion of very good photographs, which materially assist the reader in understanding the conditions of camp life in Somaliland.

The Boa Entrada Plantations, S. Thomé, Portuguese West Africa. Translated by Lt.-Col. L. A. Wyllie, F.R.S. Edinburgh and London: Oliphant, Anderson and Ferrier, 1907.

S. Thomé, a small island in the Gulf of Guinea, on the west coast of Africa, is, according to the writer of this curious monograph, not only the first agricultural colony of Portugal, but probably the first in all Africa, endowed with marvellous fertility, and producing cocoa worth something like a million sterling per annum. The French explorer Chevalier so late as 1905 pronounced it "the pearl of the Portuguese colonies." Apparently also the Boa Entrada Plantations are the cream of the island, and have arrived at this proud eminence under the careful and judicious management of the writer, who in this *brochure* describes what he has done and is doing for his estate, and defends his position with a wealth of evidence from the reports of distinguished men who have visited it. It appears that the system of recruiting for labour for this estate had been impugned from America and England as differing but little from the slave-trade, and we now have

the proprietor's reply, into the merits of which we do not propose to enter. From a perusal of it we learn a good deal about the condition of the island and the labourers, who, although they are lightly worked and liberally supplied with rations of rice, flesh or fish, beans or flour, and good wine, somehow prefer to eat dirt, have "a veritable passion for alcohol," and are decimated by anæmia, pneumonia, and dysentery. The climate is essentially swampy and sickly, and the mortality is great, even for the west coast of Africa. At the end of the volume there are a great many excellent photographs illustrative of the buildings, labourers, scenery, etc., of the plantations.

AMERICA.

The Long Labrador Trail. By Dillon Wallace, Author of *The Lure of the Labrador Wild.* Illustrated. London: Hodder and Stoughton, 1907. *Price* 7*s.* 6*d.*

Eleven months—June to May—in the cold regions of Labrador, was the time Mr. Dillon Wallace took to accomplish his "Long Trail." He himself is a good type of the explorer, possessing sagacity, courage, tact, and undaunted hope. But he modestly disclaims any credit for the plan and purpose of his expedition, declaring it was to fulfil the dying wish of his leader and companion on a former search into these trackless wilds, Mr. Leonard Hubbard, junr. To locate Lake Michikamu and the headwaters of the George River was the goal the explorers set before them. Hubbard missed it by the route he took, and perished in the attempt. Two years later, in 1905, Wallace, haunted by the request of his dead comrade, and lured by the cry of the wilderness, undertook the expedition and braved its perils, "dared and done" it, as Browning said, when he climbed La Saisiaz in pathetic circumstances. With singular simplicity he relates his narrative, keeping, you feel, a firm rein on imagination, and treading as closely as possible the solid ground of fact. He began his "Long Trail" at Hamilton Inlet, Labrador, with four companions, one of whom was a bright, active Ojibway Indian. They proceeded by canoes up Grand Lake and the Nauscaupee River. By portaging and canoeing through a series of lakes, and after some trying experiences, they at last found the Lake Michikamu. Here their food supply was in so depleted condition that the party was obliged to separate, and three returned to Northwest River. Mr. Wallace and his companion, Mr. Easton, crossed the vast lake, between eighty and ninety miles in length and from eight to twenty-five in width, and entered undiscovered country by striking the outlet of the waters into the George River, and setting at rest that problem. Through lone regions they passed, at last reaching the haunts of some Indians. Warned well by them of the rapids further down the river, they yet were caught by a sunken rock in descending a rushing stream. They were capsized into the thundering waters, and lost much of their little store, and almost their lives. Undaunted, they pushed on in spite of the oncoming winter, and at last reached Fort George, where the traders warmly welcomed them. In crossing over to the Whale River and Fort Chimo on Ungava Bay, they spent five terrible days and nights in an ice hut, and were rescued just in time. On their return by the Atlantic coast, the furies of the Arctic winter had still to be encountered, but the Moravian missionaries brightened and cheered their journey. Mr. Wallace pays high tribute to the disinterested and devoted labours of the missionaries of the Cross in these lone outposts, "who have resigned all to come to the dreary Labrador and give their lives and efforts to the uplifting of this bit of benighted humanity." Of the Indians of the North, he declares they are unspeakably

untruthful, but scrupulously honest, while the Eskimo are exceedingly dirty in their habits, but most hospitable. In an appendix he summarises briefly the scientific results of his expedition, and adds two maps to show the route traversed. His work is a distinct addition to the geographical knowledge of th world, and helps to bring the ice-sealed, forbidding Labrador within the ken of the human race.

GENERAL.

The Elements of Geography. Part I. General Geography. By J. N. Stephenson, M.A. London: Edward Stanford, 1908. *Price* 3*s.* 6*d.*

The author states in his preface that the object of this book, which appears to be intended for lower forms, is to assist in placing the "study of Regional Geography on a more rational basis." The present part is divided into four main headings:—(*A*) Astronomical Geography. (*B*) Inorganic Geography. (*C*) Organic Geography. (*D*) Cartography. The very order of these indicates that the author's mode of attack is not that which has been so often advocated here. His point of view may be indicated by a few selections from the questions at the ends of the sections. At the base of page 3 we find, "What is meant by a science? How do those of Meteorology and Ethnology concern Geography?" On page 14: "Give some account of a nebula"; "Give some account of Mars, Saturn, and the Moon"; and also, perhaps most remarkable of all, "What is meant by a 'law of nature'?" Considering that man has but yesterday reached this last-named conception, after centuries of striving, the teacher who succeeds in making it clear and real to children in the course of their second lesson in geography must be skilful indeed, nor should we personally begin the study of geography with nebulæ, or even Mars, while the earth is at our feet. Some of the later chapters please us more, but we find throughout an air of unreality due to the fact that the author begins always with formulated facts, instead of with the observations that the child may make for himself.

Traité de Géologie: I. Les Phénomènes géologiques. Par Émile Haug. Paris: Librairie Armand Colin, 1907. *Price* 12 *francs* 50 *centimes.*

This work is apparently designed to supply what has long been wanting in French, namely, a text-book intermediate in character between the ordinary elementary manuals and those rather extensive treatises which appeal more especially to professional geologists. An intermediate text-book, the first part of which contains over 500 pages (and the concluding part will hardly be less bulky), cannot be said to err on the side of brevity. In compiling geological text-books there is not much scope for originality so far as the actual materials are concerned —for these are simply the accepted data of the science. It is the manner, therefore, in which the phenomena are described, illustrated, classified, and explained, that makes a manual good, bad, or indifferent. Some text-books are entirely reliable and yet deadly dull. Lack of logical arrangement, disproportionate treatment of details, and a heavy lumbering style that muddifies even the simplest matter, more than counterbalance all the painstaking accuracy of the compiler. On the other hand, there are text-books neither so complete nor so reliable as these dull and unreadable productions, which are nevertheless so brightly written that their perusal becomes a pleasure. It is among the latter that we should class Professor Haug's work. His style is at once clear and graphic, and the book is so abundantly and cleverly illustrated that it cannot fail to attract the attention of

his studious fellow-countrymen. The numerous bibliographical references will be much appreciated by the reader who desires to consult original sources of information on the various subjects discussed by the author. Unfortunately, as we think, Professor Haug has not been content to set forth the well-ascertained facts of the science and the principles upon which these are to be interpreted—he has not confined himself merely to descriptions of phenomena and more or less generally accepted theories or explanations, but has freely indulged in speculations and hypotheses—the worth of which no beginner is in a position to estimate. Highly controversial matter of this kind, if it must be included in a text-book for students, ought either to be relegated to an Appendix, or be so treated that the student should be left in no doubt as to its character. It is true that amongst the subjects discussed are some of the largest and most important problems of modern geology, and what our author has to say on these much controverted questions is often interesting and even suggestive. But we repeat that questions of the kind referred to can only be profitably considered by experts. They are out of place, it seems to us, in a text-book for young students. How, we may ask, can a beginner appraise the value of the author's hypothesis, for we cannot call it a theory, of "geosynclinals and continental areas"? Professor Haug believes that Dana's doctrine of the permanence of the dominant undulations of the earth's crust has been done to death by Professor Suess. This, we may remark in passing, is far from being the view held of that doctrine by geologists generally. According to our author, what now constitute the great ocean basins formed, during Mesozoic times, vast continental areas; indeed, no oceans to speak of existed in those days. The seas were represented chiefly by relatively narrow and sinuous belts, in which the Mesozoic and younger strata were accumulated and there attained their greatest thickness. These narrow belts form Professor Haug's geosynclinal troughs. Towards the close of Tertiary times his hypothetical continental areas subsided. As each vast area sank down, the intervening troughs or geosynclines were subjected to enormous lateral pressure, and thus it came about that the strata with which they had been largely filled were mashed together and buckled up to form all the recent mountain-chains of the Globe—Alps, Caucasus, Himalaya, Rockies, Andes, etc. Having accepted the view that the formations entering into the composition of mountain-chains have always been accumulated in narrow geosynclinal troughs, M. Haug does not hesitate to postulate the former existence of an extensive Pacific Continent, in order to account for the presence of the great mountain-chains that now border the Pacific Ocean. It need hardly be said there is no evidence that any Pacific Continent ever existed, and indeed the author frankly admits as much. Since he believes, however, that Professor Suess is right in postulating the former existence of a great North Atlantic continent separated by a geosynclinal trough (forming a kind of inland sea connecting the Mediterranean with the Gulf of Mexico), from a similar great South Atlantic continent, one might have expected the author to explain the absence of any lofty mountain-chain on the site of the conjectural geosyncline. When the North and the South Atlantic continents subsided, why did not they squeeze up the intervening geosynclinal formations into chains and ranges comparable to the Alps and the Andes? If such mountains ever existed, they have now mysteriously vanished and left not a trace behind them. The author is so enamoured of his "geosynclines," that they are brought forward to account for the phenomena of metamorphism. He writes so clearly and persuasively that the inexperienced student will be apt to accept the author's speculative views as the only explanation of the phenomena. Reference is indeed made to the competitive theory of dynamo-metamorphism, but it is finally dismissed almost contemptuously. We

do not hold a brief for either the one theory or the other, but believe, with Sir Roger de Coverley, that there is a good deal to be said on both sides. The views held by French geologists on the difficult subject of metamorphism are deserving of much more consideration than they have generally received out of France; on the other hand, the theory of dynamo-metamorphism has much more to be said for it than one would gather from M. Haug's perfunctory treatment of it. The probabilities are that the whole truth lies neither with the one view nor the other From what we have said of the present text-book it will be gathered that the work is marked by freshness and originality of treatment, and will well repay perusal and study by the English reader.

Travels of Peter Mundy in Europe and Asia, 1608-1667. Vol. I. Edited by Lieut.-Colonel Sir Richard Carnac Temple, Bart., C.I.E. Cambridge: Printed for the Hakluyt Society, 1907.

If the number of miles over which he has passed be any criterion of his title to fame or importance, then Peter Mundy of Penryn in Cornwall has a fair *prima facie* claim to being one of the most distinguished travellers of the seventeenth century. His own calculation is that between 1611 and 1647 he travelled upwards of 100,833 miles, or something like 3000 miles a year, in days when travelling was very different from what it is now. He spent some time in France and the Channel Islands, made repeated visits to Spain, traded in Holland, Russia, Prussia and Poland, sailed to Constantinople, returned home overland, and made three voyages to India. He greatly regretted he had been unable to make a circumnavigation of the world. There is, happily, a complete MS. of his journal in the Bodleian Library at Oxford, the publication of which has now been undertaken by the Hakluyt Society, as an inspection of the MS. shows it to contain "seventeenth century accounts of practically the whole of Continental Europe, parts of England and Wales, Western India, China and Japan, besides containing historical notes of no little value." The arduous work of editing has been entrusted to Sir Richard Carnac Temple, who is already favourably known to our readers as editor of Thomas Bowsey's *Geographical Account of Countries around the Bay of Bengal*, which we reviewed in the issue of this *Magazine* for November 1905. Sir Richard Temple in the preface of this work remarks that "it is doubtful if any other contemporary work of equal merit exists. The value of such a MS. to the student can therefore be hardly overestimated, especially as a careful examination has shown that the author was an educated man, who, unlike most writers of his day, does not indulge in 'traveller's tales,' unless he qualifies them by the saving clause 'This by Relation.'" The MS. is of great length; Mundy himself divides it into thirty-six Relations; so for the purposes of publication it has been subdivided. In the volume now before us we have only the first three Relations, comprising Mundy's account of his early European travels, the most important of which is his itinerary of the overland route from Constantinople to London. These took place between the years 1608 and 1627. In passing we may call the attention of our readers to the interesting fact, noticed by the editor, that the overland route over which Mundy travelled in 1620 is practically the same as that of the Orient Express of to-day between Constantinople and Belgrade. For the instructive and interesting details of his account of his travels in these "Relations" we must refer our readers to the work. As usual in the Hakluyt publications, we have an erudite and careful introduction by the editor. In this he has collected together with much patience and skill all the information now available about the personal history of Mundy, and he

pronounces a judicious and impartial appreciation of his position and worth as an authority and of his character as a man.

We must also direct attention to two quaint illustrations which are exact reproductions of Mundy's own drawings, and to the interesting appendices from unpublished or little known works, which supplement Mundy's information. We anticipate with much pleasure the publication of the succeeding volumes of this work, feeling sure that in the skilful hands of Sir Richard Temple they will prove as interesting and instructive as the one now before us.

The Private Diary of Amanda Ranga Pillai. Translated and edited by Sir J. Frederick Price, K.C.S.I. Vol. II. Madras: Printed by the Superintendent, Government Press, 1907. *Price* 4*s.*

In the issue of this *Magazine* for February 1906 we noticed the first volume of the diary of the Indian Pepys, Amanda Ranga Pillai, in which he records in his own inimitable style the events which occurred at Pondicherry in the ten years, 1736 to 1746, under the French governors Le Noir, Dumas, and the famous Dupleix. We have now before us the second volume of the diary, which continues the author's record of events, but for a much shorter period, viz. between April and October 1746. Of these much the most important was the arrival at Pondicherry of De La Bourdonnais with his fleet, his capture of Madras and subsequent mutiny against the authority of Dupleix. During this period it is clear that Amanda Ranga Pillai was on most confidential terms with Dupleix and his wife, neither of whom hesitated to make use of him for the purpose of obtaining considerable bribes in connection with various official transactions. He had not yet been appointed *dubash* or courtier, but his qualifications and claims to the lucrative and influential post were generally admitted, and he had an enthusiastic supporter in the person of Madame Dupleix, who, he tells us, assured him that both Dupleix and himself looked upon him as their son. His answer was characteristic. "Madame, I am his (*i.e.* Dupleix's) slave. I can hope to discharge my obligations to him only, when he, by re-incarnation, is born to me as my son, but not otherwise. This is my firm conviction." And as a matter of fact the diary shows that he threw himself, heart and soul, on to the side of Dupleix. The second volume of the diary is quite as interesting and instructive as its predecessor, and unconsciously sets before us a vivid and fascinating picture of what happened at one of the most critical periods of the prolonged struggle between England and France for supremacy in the East.

International Congress of Prehistoric Anthropology and Archæology. Report of the Thirteenth Session held at Monaco in April 1906. Tome 1er. Monaco: Imprimerie de Monaco, 1907.

This interesting volume opens with valuable contributions by the highest authorities on the Prehistoric Remains in the district of Monaco, notably of its famous caverns known variously as the Rochers rouges, Baoussé-Roussé, and Grottes de Grimaldi. A general description of these caverns appeared in this *Magazine* in 1903 (pp. 281 and 376) under the title "Primitive Man, as revealed by recent Researches in the Caves near Mentone." An important discussion took place at the Congress regarding the human skeletons found in these caverns, two details being more particularly referred to. The first related to the

prehistoric decapitation and red ochreous coloration of the dead. M. Verneau considered that many of the dead were buried in these caverns (during Pleistocene times) in ochreous beds, but that several were not subjected to the funerary rite of coloration. Sir John Evans cited a poem by Schiller describing the burial of a savage who had received colours to paint himself with in the next world. M. Reinach commented on a letter from St. Ambrose to his sister concerning the discovery at Milan, A.D. 324 (near a Basilica which was being constructed), of a prehistoric grave containing two skeletons of great length found decapitated and covered with red ochre. St. Ambrose, said M. Reinach, completely misinterpreted this discovery, for he imagined that these were the blood-stained skeletons of Christian martyrs who had been decapitated during the early persecutions, ignoring the prehistoric funerary rites of decapitation of the dead and their coloration with red ochre.

The second subject discussed was the strange prehistoric custom of burying the dead in caves actually inhabited by the living; but Lieutenant Desplagnes pointed out that in West Africa chiefs are often buried in dwellings which continue to be inhabited.

Very interesting papers were contributed by the Abbé H. Breuil and others on the artistic efforts of Prehistoric Man. From observations which the Abbé had made in the Caves of Altamira, Marsoulas, Combarelles, and Fort de Gaume, he recognised five artistic phases, the first or earliest being illustrated in this volume by rude sketches of animals (a bison, goat, horses, etc.); the second phase by a well-modelled bison and sketches of a mammoth, horse, etc.; the third by a well-drawn deer; the fourth by several bisons; and the fifth phase having no mural drawings or frescoes, but figures like bands, branches, links of points, punctuated surfaces, and also a cross within a circle.

Dr. Capitan and others furnish illustrations of Carnivora figured in the Caverns of Périgord, including a tiger, several bears, a wolf, a fox, and also a carefully designed Rhinoceros. They also give, from the Cavern of Combarelles, illustrations of strange anthropomorphic or human forms, creatures ranging, in outward appearance, from the monkey to the man, and concerning which the authors ask: "What explanations can be offered regarding these designs? Are they primitive caricatures? or drawings of imaginary beings such as all primitive cosmogonies have conceived, with badly designed human faces after the manner of the Eskimo magicians, the Red Indians, or the Australians? We are inclined to accept this hypothesis from the ethnographic comparisons which we submitted to the Congress."

From even the above selections it will be seen that this volume will furnish a most valuable fund of information to all interested in the archæology of the human race, and that its local papers should greatly add to the attractions of the beautiful district in which the Prince of Monaco (the Patron of the Congress) is not merely reigning Sovereign but also the leading man of science.

Active Service Pocket Book. Third Edition, enlarged. By BERTRAND STEWART. London: William Clowes and Sons, N.D. *Price* 4*s. net.*

The chief points of interest to us in this little book are to be found in Part xi., entitled Field Sketching, which gives a clear and simple account, illustrated by diagrams, of the simpler methods of preparing sketch maps in the field, with also some paragraphs on freehand landscape sketching. This section may be recommended to the notice of teachers.

BOOKS RECEIVED.

We have received the following new books, which will be reviewed in due course :—

Modern Egypt. By The Earl of Cromer. In two volumes. Demy 8vo. Vol. I., pp. xviii + 594. Vol. II., pp. xiv + 600. London : Macmillan and Co., 1908. *Price* 24*s.*

L'Homme et la Terre. Par Élisée Reclus. Demy 4to. 4 volumes. Vol. I., pp. iv + 580 ; Vol. II., pp. 576 ; Vol. III., pp. 639 ; Vol. IV., pp. 651. Paris : Librairie Universelle, 1908. *Prix* 20 *fr.* per vol.

To Jerusalem through the Lands of Islam. By Madame Hyacinthe Loyson. Preface by Prince de Polignac. Royal 8vo. Pp. viii + 325. Chicago : The Open Court Publishing Co., 1908.

Travels in Tartary, Tibet, and China during the years 1844-56. By M. Huc. Translated from the French by W. Hazlitt. Two vols. in one. Demy 8vo. Pp. xviii + 660. Chicago : The Open Court Publishing Co., 1908.

A Rational Geography. By Ernest Young, B.Sc. Part I., Climate, British Isles, Europe. Part II., Tides, Winds, Currents, Latitude and Longitude, America and Africa. Crown 8vo. London : Geo. Philip, 1908. *Price* 1*s.* 6*d. each.*

Three Voyages of a Naturalist, being an Account of many Little-known Islands in Three Oceans visited by the Valhalla *R.Y.S.* By M. J. Nicoll. With an Introduction by The Rt. Hon. The Earl of Crawford, K.T., F.R.S. Demy 8vo. Pp. xxvi + 246. London : Witherby and Co., 1908. *Price* 7*s.* 6*d. net.*

Spain and Portugal : Handbook for Travellers. By Karl Baedeker. With 9 Maps and 57 Plans. Third Edition. Pp. xcvi + 588. Leipzig, 1908. *Price* 16*s.*

Mittelmeerbilder : Gesammelte Abhandlungen zur Kunde der Mittelmeerländer. Von Dr. Theobald Fischer. Neue Folge mit 8 Kärtchen. Pp. vi + 426. Leipzig : B. G. Teubner, 1908. *Preis* 6 *m.*

And the following Reports, etc. :—

General Report on the Operations of the Survey of India administered under the Government of India during 1905-1906. Prepared under the direction of F. B. Longe, R.E. Calcutta, 1907.

Directory of Merchants, Manufacturers and Shippers, and Guide to the Export and Import, Shipping and Manufacturing Industries of the World. 1908. Pp. 3260. London : Kelly's Directories, Limited, 1908. *Price* 30*s.*

Stromstudier vid Östersjöns. Portar. af O. Pettersson. Pp. xxiv. Stockholm, 1907.

Baluchistan District Gazetteer Series. Compiled by Major A. M'Conaghey, I.A. Sibi District, Bolan and Chagai and Maknán and Khárán. 3 Parts. Bombay, 1907.

Central Provinces District Gazetteer. By C. E. Low, I.C.S. Balaghat District. Allahabad, 1907.

District Gazetteers of the United Provinces of Agra and Oudh. By H. R. Nevill, I.C.S. Badaun. Allahabad, 1907.

N.W.F. Province District Gazetteers. Hazara District. Peshawar, 1907.

Bengal District Gazetteers. By L. S. S. O'Malley, I.C.S. Palaman, Patna, and Champaran. 3 vols. Calcutta, 1907.

Madras District Gazetteers. By F. R. Hemingway, I.C.S. Trichinopoly. Madras, 1907.

Maryland Geological Survey. Calvert County and St. Mary's County. Baltimore, 1907.

Publishers forwarding books for review will greatly oblige by marking the **price** *in clear figures, especially in the case of foreign books.*

THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE REPUBLIC AND CANTON OF GENEVA.

A DEMOGRAPHICAL SKETCH.

By Victor Dingelstedt, Corr. Memb. R.S.G.S.

The Canton of Geneva is the first among the twenty-two Swiss Cantons constituting the Swiss Confederation to convoke the Geographers of all the world to an International Congress, which surely indicates the pre-eminence it enjoys among them for its splendid geographical situation, its culture, its enlightened initiative, and the facilities and comforts it offers to its numerous foreign visitors.

The Congress promises to be a success and a new step in the advance of geographical science; there are already about one hundred and fifty papers announced for the benefit of its future members. In the meanwhile we may take this opportunity of calling the attention of our readers to the state which so graciously offers its international hospitality.

The present writer is an old resident at Geneva, who has had opportunies of studying this canton by means of official documents (liberally put at his disposal by the Bureau of Statistics) from the demographical point of view, which may not be considered by all as strictly geographical; yet it has certainly a very close correlation to geographical science. The movement of population, or vital statistics, indicate the laws governing the reproduction, the maintenance, and the decay of what is, after all, the principal subject of Geography—the inhabitants of the Earth.

The writer proposes in this paper to cast a general glance at the varied elements of the Genevese population, considering afterwards the different agents that are binding these elements together, and conclude with the data concerning the movement of the population, its birth and death rates.

As in every natural phenomenon, there are natural laws which govern the conscious as well as the unconscious, the voluntary as well as the involuntary conduct of states and communities, the development

of their commerce or industry, their decay and prosperity, the increase or decrease of their population, the birth and death rate, the incidence of disease, and so on. No Newton has as yet been born to reveal the laws which make it possible for human societies to exist and to maintain themselves, but there are already sufficient reasons for presuming that they depend primarily upon the natural environment, the object of Geography—air, water, soil, temperature, food, animals and plants, etc., and secondly upon man himself as living organism, the object of anthropology, sociology, and other sciences.

The laws governing the conduct of societies seem as yet terribly obscure; there has been much done in the past to obscure them by superstition and ignorance, and by their complicated nature they are difficult to unravel, yet there is no reason to abandon in despair the hope of understanding them better by means of a long process of patient research. It is only necessary as an indispensable preliminary to observe exactly the actual social facts concerning vital statistics.

Considering the complexity of the subject and the facility with which one may err, it is evident that this kind of study can be most fruitfully pursued in relatively small and highly civilised communities, possessing well organised bureaux for accurate registration of the facts concerning the movement of population.

The Swiss Canton of Geneva may certainly be considered as one of those communities whose study promises to be fruitful.

One word about Switzerland as a whole. Switzerland presents an admirable mixture of heterogeneous ethnic elements, different in temperament, customs, language, creed and traditions, which have succeeded, thanks to the common danger and community of interest, in establishing an important homogeneous, self-sustaining confederated state, a patriotic nation, strongly united in the face of the outer world in everything essential for the defence of the common welfare, without losing much of the local privileges and peculiarities; permitting every canton to govern itself and enjoy life according to the wishes of a considerable majority of its population.

The Republic of Geneva thrives under the ægis of the Federal white cross on the red field.

The great diversity of character in the different Swiss cantons, and of the constituent elements within each canton, though inevitably accompanied by some friction, have on the whole led both to the greatest enjoyment of the association and to the most complete ultimate development of each canton. In the midst of four great conflicting and jealous powers the Swiss have succeeded in establishing a confederation of twenty-two autonomous republics, having one army and only one representative in their foreign relations, giving a sure asylum to the persecuted victims of foreign intolerance, and permitting each to develop and progress more fully according to the particular genius of each component portion, its religious creed, its moral and intellectual inclinations, the conditions of its soil, its climate, its history and traditions.

Switzerland constituted a nation not in consequence of the normal laws of growth and blood relations, which presided at the birth and develop-

ment of other nations, but in consequence of identity or community of interest in defence against powerful neighbours, under the protection of the mountain ramparts. These heterogeneous ethnic elements may perhaps not have the same truly national feeling which naturally animates other nations, there might even have been not unnatural antipathies between them, but there is instead a powerful patriotism, a genuine love of a beautiful country, which assures to its denizens self-government and liberties, which vibrates with past heroic deeds, and by the common effort of all its sons has been permitted to attain this happy result. At every official occasion, and they are numerous, the note of patriotism sounds here high and clear.

The Swiss have no colonies of their own, but they swarm over the world, and have established everywhere their colonies under foreign jurisdiction. As emigrants they never lose the love of their mother-country, their canton or village, and as often as not they return to die there, their fortune made. Thus, though pent in the narrow borders of their mountains, the Swiss preserve the faculty of seeing beyond these borders, of sympathising with the whole of humanity, and of becoming inspired by ideas of universal peace and brotherhood. There is not only mutual tolerance but something of an interchange and diffusion of most varied sentiments and ideas, leading to a broader conception of life and to mutual education. Switzerland serves as an excellent buffer state. According also to A. R. Wallace, "ever-delightful Switzerland is the sanatorium and Alpine garden of overworked Englishmen."

Such is the glorious mother-country of which the Republic and Canton of Geneva is one of the loveliest and most beautiful daughters.

The Canton of Geneva.

Before speaking about its population it is necessary to say a word about its climate and territory.

Climate.—The Canton of Geneva rejoices in a healthy, bracing, highly variable but moderate climate, which must be considered as very favourable for the physical and intellectual development of all except excessively delicate persons.

The mean average annual temperature = 48·83° F.
" Winter " = 33·35° "
" Spring " = 48·06° "
" Summer " = 64·13° "
" Autumn " = 49·46° "

	Relative Humidity.	Precipitation.	Cloudiness.	Insolation.	Atmospheric Pressure.
Annual	77 per cent.	816 mm.	6·2	1966 hours	726 mm.
Winter	85 "	137 "	7·6	164 "	727 "
Spring	72 "	183 "	5·9	524 "	725 "
Summer	69 "	227 "	4·8	844 "	727 "
Autumn	81 "	269 "	6·6	134 "	726 "

In comparison with the first half of the last century the mean annual temperature, atmospheric pressure, humidity and rainfall have slightly decreased. It is possible to work in the open air almost the whole year; stonemasons' work is hardly stopped for six weeks.

Prevalent north winds, called "Bise," bring clear weather about 157 days in the year; south and south-west winds bring rain about 128 days; about 80 days in the year are calm.

The coldest month in the year, January, has a mean temperature (deduced from continual observations by Emile Plantamour, from 1826 to 1875), of 30·4° F., but during the last two years, 1906 and 1907, it was warmer, 35° and 39° respectively. In the warmest month in the year, July, the mean average temperature is 65·96°, but it happens sometimes, as for instance last year (1907), that August, with a mean temperature of 66·36°, was warmer than July.

Territory.—The 108 square miles of Genevese territory, mostly of alluvial, rather poor soil, are situated on both shores of the south-western corner of the Lake of Geneva, and on the right bank of the Rhone between the Jura on the north and the Salève on the south. The lake is at a level of 1220 feet above the sea. The land gradually rises towards the mountains; there are some small hills, but the most elevated point in the canton, the Signal of Bernez, attains only 1656 feet.

Population.—One of the smallest as to its area, the Canton of Geneva occupies the sixth place for its population among the twenty-two cantons of Switzerland, after Berne, Zürich, St. Gall, Vaud, and Aargau. It is the most thickly populated Swiss canton, numbering, according to the last census (1906), 147,047, or 1400 inhabitants per square mile. The growth of the canton and the city was checkered and unequal in the most momentous phases of its eventful history. At the time of the contests between the Helvetii and the Romans, Geneva belonged to the country of the Allobroges. It was afterwards included in the Roman Provincia Maxima Sequanorum. It was alternately under the dominion of Burgundy, the Ostrogoths, the Franks, and Burgundy once more. In 1518 the Genevese concluded an alliance with Freiburg, and shortly after with Berne, and thus Geneva became a member of the Swiss Confederation. In 1798 the Republic became the prey of an ambush by a French agent, Desportes, and remained in the possession of France up to 1813, when it was restored to independence and its former alliance with Switzerland.

At the time of the Reformation, in which Geneva was called upon to play such an important and influential *rôle*, it included about 13,000 inhabitants. After Calvin's time the population increased very slowly at the rate of about 2 per 1000 annually, and arrived in 1698 at 16,934.

In the eighteenth century up to the French Revolution the increase was steady and more rapid, at a rate of about 7 per cent. per annum. The city numbered, in 1789, 26,140, the canton 35,000 inhabitants. But the Revolution was a stormy time for Geneva. Enclosed on three sides by French frontiers, it lost its independence, and with it a considerable number of its inhabitants, sent to be killed in a foreign cause:

so that a period of almost forty years was necessary to allow the unfortunate city, some time after its re-entrance into the Swiss Confederation (1813), to recover the same number of inhabitants it possessed before the great political hurricane. At the moment of restoration to its former political situation as a member of the Swiss Confederation (1813) it included 48,498 inhabitants.

There then opened for Geneva an era of unprecedented prosperity, and at the time of the first general census, organised by the Federal Council in 1850, the Canton of Geneva numbered 64,146; in 1880 101,595; and in 1900 more than double the figure in 1850—*i.e.* 132,609. For the last seven years in the present century it has increased regularly at the rate of 18·1 per 1000. In the present year (1908) the canton has a population of about 150,000 (149,196).

This population dwells in the city and its suburbs, and in rural communities. The city and its suburbs constitute together the so-called Genevese agglomeration, with 118,594 inhabitants.

The City and its Suburbs.—The old city is situated on both sides of the Rhone. Most of our readers must know the picturesque old town on the left bank of the river, built on a hill around its beautiful Gothic Cathedral of St. Pierre, which dominates the large expanse of lake and the adjoining green plain. Formerly it was fortified and had an enclosure, which was vainly assailed for the last time in 1602 by the Duke of Savoy —a feat vividly recalled until the present days by an annual noisy carnival under the name of "Escalade." The other part of the town, called formerly "Geneva minor," on the right bank, has for its centre the church of St. Gervais, built also on a hill. These two ancient sanctuaries, belonging to two different races—the Helvetii and the Allobroges—have been the two centres of formation of the actual city of Geneva. They differ in character, and there was a certain rivalry between them for a long time. From these two quarters building gradually extended towards the river until they merged into one with no trace of the ancient divisions, united by numerous bridges, and yet more numerous bonds of friendship and interest. In the midst of the stream are placed hydraulic motors, giving light and power for the cars. The old borders of the two towns have been converted into beautiful quays and promenades, with on one side a row of magnificent buildings, and on the other a splendid view of the lake and mountains, where among a cosmopolitan crowd it is quite impossible to recognise who are the descendants of the Helvetii and who have for their ancestors the Allobroges. All are there to admire the beauty of Nature, the peace, industry, and contentment of the splendid surroundings. The two old enclosures of the city, though grown to their ultimate limits, have conserved some special characters and some historical relics of the past, in their narrow and winding streets, towers, and curious buildings; but the old houses are gradually being pulled down, the streets enlarged, and the whole is acquiring a modern monotonous aspect. The old Allobroge city with its many quaint nooks has become mainly the seat of government and the home of the law courts, of the municipal and administrative offices, of museums, of some belated aristocrats; it is noiseless, calm, and respectable.

The suburbs, having grown out of four adjoining communes—Plainpalais, Eaux-Vives, Petit-Saconnex, and Carouge—have, with the exception of the last, which still maintains its old aspect of a small provincial town, an entirely modern character; they rival one another in embellishing their respective quarters after the current ideas of beauty, whose principal traits are straight lines and uniformity. The suburbs have already a few more inhabitants than the city proper or *la ville*, but it is always *la ville* which is the directing brain, bearing the heaviest charges and the responsibility for maintaining order, cleanliness, good education, security, everything indispensable for the high requirements of a modern city aspiring to be one of the pleasantest, healthiest, and most comfortable in the world. The town has, in fact, many attractions; it has almost all the resources of a great city, without its inconveniences. The crowd is always orderly, and there is no rabble, no sorrowful spectacle of beggars, drunkards, loafers, nor destitute and afflicted persons such as one meets with in all big cities.

Yet there remain improvements to introduce in order to fulfil all the high aspirations of the city. Without speaking of the old quarters constructed in defiance of the most elementary rules of hygiene and constituting dangerous nests of pathogenic microbes, there have been tolerated even in the most of the new quarters and suburbs some serious defects from the point of view of the requirements of public and private hygiene: the interior courts are generally too narrow; in many houses air and light are insufficient—the back rooms, kitchen, staircases, etc., are often quite dark; and whilst the streets have usually a breadth of about fifty feet, the mean average height of the houses is sixty and even sixty-seven feet, therefore the aeration of the lower floors is quite insufficient. All this cannot but influence unfavourably the death and disease rates.

Rural Communes.—At the Restoration (1813) the country was divided into thirty-six communes, of which four, viz. Petit-Saconnex on the north, Plainpalais and Carouge on the south, and Eaux-Vives on the east of the city, were later incorporated, with maintenance of their separate communal administrations and privileges, into the *agglomération genevoise*. There are now forty-three communes, of which the most important are: Versoix, Céligny, Grand Saconnex on the north; Vernier, Satigny, on the west; Lancy, Bernex, Chancy on the south-west; and Collonges, Corsier, Hermance, Jussy, Vandœuvres, Thonex, Chêne-Bougeries on the east. These enjoy generally considerable prosperity, are beautifully situated on the shore of the lake and at the foot of the Salève and the Jura. The vicinity of dung-heaps and cattle-sheds to the dwellings, and their confined air, are however drawbacks. They now include altogether about 20 per cent. of the whole population of the canton. The whole canton is traversed in all directions by electric tramways; all the villages enjoy good roads, mostly lighted by night; in every village there are excellent primary and secondary schools, and each commune is self-governing.

Elements of Population.—The population of the canton consists of three different elements, viz. (1) the indigenous, or Genevese proper;

(2) the Confederates, or Swiss of other cantons; (3) foreigners domiciled in the canton. The proportion of all these elements in 1906 was as follows:—

	Genevese.	Confederates.	Foreigners.	Total.
City, . . .	18,344	16,881	24,464	59,689
Suburbs, . . .	18,293	14,617	23,846	56,756
Country, . . .	13,531	6,211	10,860	30,602
Canton, . . .	50,168	37,709	59,170	147,047

Of these three elements the principal one, the natives or masters of the country, has a tendency to decline; its death-rate is higher than its birth-rate, and it is only thanks to the naturalisation of Swiss and foreign elements at the rate of 2 per cent. per annum that the loss is made up. The Swiss element of the population increases only at the rate of 1·8 per cent. per annum, whereas the foreign element increases steadily at the rate of about 2·8 per cent.; it numbered 15,142 in 1850, 35,564 in 1870, and 52,644 in 1890.

The relative proportion of the three mentioned elements of population, Genevese, Swiss, and foreign, is actually at 342, 257, 402. This proportion is yet more in favour of aliens in the city proper (316, 267, 417), and there is already a rural community where the foreigners are more numerous than the indigenous element.

Native Population.—The Genevese are the masters of the country; they have all the responsibility, they occupy all places of honour and distinction, and to fulfil all that they have very high qualities. In spite of the smallness of their number and of their territory they have played a conspicuous part in the history of civilisation; they have conquered and maintained their independence in face of very difficult circumstances; they have maintained order and discipline, and have brought their country to a very high rank among the most civilised countries of the world, have made it an asylum for persecuted refugees, and given it such attractions that a hundred thousand foreigners visit it yearly, and come to reside in it in order to enjoy both the advantages of its climate and situation, and of its high culture and material comfort. There is no wonder that a race which has accomplished all that is a proud, self-conceited race, jealous of its rights and privileges, and imbued with the consciousness of its high moral and intellectual value. *Il n'y a que nous* is a phrase which one may hear often in Geneva.

The Republic and Canton of Geneva is a purely democratic community, but it is a democracy of culture, not in any way excluding individual and social distinctions. Though all are equal before the law, yet there is a landed and financial aristocracy, highly cultured, respectable and dignified, distinguished, patriotic, active, serious, favouring religion and the arts and sciences. The aristocratic spirit, as has been truly

observed by Professor T. C. Hall, is stamped on Calvin and Calvinism. There is also *La haute Bourgeoisie*, industrious, enterprising, cultivated, equally patriotic and moderately conservative; there are artisans and workmen of different kinds, with more advanced political and social ideas, forming the free-thinking and socialistic classes, but there are almost no paupers, no truly indigent persons, no vagabonds, no loafers—at least, all those undesirables are cared and provided for. Whilst always bearing in mind those distinctions of classes created not by laws but social life itself, and which no law can ever completely abolish, one may distinguish among the Genevese, as in all ancient communities, the people of old stock, the other of modern tendencies, and again those who are Genevese but by name, being of foreign blood and recently naturalised.

A true Genevese has a strong moral fibre; he is honest, orderly, inclined to criticism, not easily satisfied, grudging, and at the same time humorous, facetious, jocular, and religious. A Genevese is almost as quick as a Frenchman, with whom he has also in common the language, versatility, gentleness of manner and urbanity. The modern Genevese have felt strongly the influence of France, which encircles the canton on three sides, and has here a numerous and rich colony. Genevese do not pursue their ends with as much tenacity as Germans or Swiss-Germans, nor have they the German perseverance, industry, patience, and discipline. Many Genevese families, in order to permit their children to acquire all those more German qualities, send them willingly for some years to Zürich, Basel, Germany, or England. The Genevese is intensely patriotic, but though an intelligent soldier, he does not much like military service; neither does he seem to possess the faculties required from a worker in great manufacturing industries, with their strict discipline and monotonous and uniform procedure. Thanks to his good school education, the Genevese prefers skilled labour, and being quiet, intelligent, active, practical, he gives his preference to such more remunerative and fine work as watchmaking, jewellery, enamelled work, spectacle-making, musical boxes, typography and printing, banking operations, etc., all of which allow some freedom of spirit, independence of thought, and the chance of some discovery or invention.

He likes festivities and entertainments of every kind greatly. These under different names—*kermesse, abbayes, bénichons, fêtes champêtres*—and under different pretexts, such as sports, gymnastics, shooting anniversaries, musical competitions, exhibitions, etc., are very numerous and expensive. The gatherings have mostly a patriotic character, and the officials are expected to make stirring speeches at them.

The Genevese, without being an artist or so enthusiastic a lover of Nature as the Italians and Germans, is physically and mentally active. He is a good pedestrian and mountain climber; every Sunday and on Thursday afternoon crowds may everywhere be seen on the roads traversing the well-cultivated and flourishing country.

Being rather mystical, the Genevese interests himself in religious matters, but he is practical at the same time. He does not like niceties or what is vague and uncertain; he is inclined to pedantry; he likes to put the dots on his i's, and has a genius for mechanics. Modesty is not his

dominant virtue, and the term *âme genevoise* is meant to signify something very high and noble indeed.

The common popular type of a young Genevese of the town is represented as a merry companion and good fellow, widely awake, shrewd, quick, easily adapting himself to all circumstances of life, satisfied with himself, more easily led by moral influences than coercion, and rather hot-headed.

The country people are cautious and rather slow, prudent and distrustful; they are patient, conservative, but not at all enemies of progress. Agriculture, and especially wine and fruit-growing, dairy produce and cattle-raising, are conducted according to most rational methods. The Genevese seems to present a very happy mixture of Latin and Saxo-German blood. He is less lively and impressionable, less frivolous and graceful, than the Frenchman or Italian; less phlegmatic, reflective, and reticent than the German; less practical and businesslike, and more idealistic than the Englishman. He is polite and friendly but in a measure. He is not litigious, and readily consents to have his differences arranged by an umpire.

The people have a liking for wine and strong liqueurs, which causes a number of small offences, but serious crime is rare. The large lunatic asylum is however full.

The men gather in the evening in their numerous coffee-houses, clubs, circles, and taverns, where they discuss public and private affairs, play cards and billiards, and drink. The women, far more numerous than the men, deserve high praise; they are industrious and sensible, well instructed, and mostly work and win their bread in a considerable number of places and occupations opened to their activity, as for instance as shopgirls, clerks, telephone-girls, barmaids, domestic servants, lady-helps, governesses, teachers, etc. The rich and well-to-do classes work much for the benefit of the poor.

Famous Men.—It is no wonder that in such favourable conditions of political and religious liberty, and with such excellent public education, the Genevese soil has given an abundant crop of men famous in all branches of science, and useful human, intellectual, and moral activities. There are at least two or three famous Genevese for each square mile of the area of the canton. It is impossible in the limits of this paper to enumerate all the Genevese celebrities, whose names have been mostly perpetuated in the naming of streets and public places. The greatest child of the soil was J. J. Rousseau (1712-1778), but his genius has been recognised tardily; and it is to a Frenchman, Jean Calvin (1509-1564), long before his time, that the Genevese mainly owe their moral and intellectual education.

There are still foreigners who continue to treat a native Genevese as a Calvinist, so strong is the impression left on the national character by this extraordinary man. He has impressed on the mind of the Genevese the stamp of a rigid morality, and, strangely enough, awakened the taste for exact sciences. Calvin also founded the academy. Considering the gigantic action of a single man not upon his own generation only, but upon a series of generations after him, there is surely some truth in the

affirmation that the so-called national type derives not so much from the blood or the race, but from the life in common, the civilisation, religion, great ideas, or the influence of a great man. Confucius, Mahomet, and also Calvin, though on a smaller scale, have stamped their influence on a human community, and contributed to form its character in a degree that may be considered as superior to the influences in the same direction exercised by the blood tie or by race. This extraordinary action of one man must, however, be considered in conjunction with other natural factors—as language, history, climate, etc.

Calvin has raised the mental activity of the Genevese mainly in the direction of theology; by his and his friend Farel's action, the most distinguished men of this country devoted themselves to this subtile science either as pastors or pious laymen, and especially to exegetical theology in which occur so many nice controversies. Charles Perrot (1514-1608), Benedict Pictet (1655-1724), Lullin Amedee (1695-1736), Prevost, Diodati, Turretini, during the three generations from 1588 to 1637, among many others have given Geneva universal renown as a seat of profound Protestant learning.

But Geneva can boast also of a considerable number of naturalists, geologists, mathematicians, physicians, natural philosophers, and other savants, and we may mention at hazard such names as Elie and Louis Bertrand, Augustin Pyramus de Candolle (1778-1841), Alexander Marcet (1770-1822), well known in England, Louis Neckar (1730-1804), Jean and-Marc August and François Jules Pictet, Jean, Pierre, and Isaac Bénédict Prevost, Abraham Trembley (1700-1784), Senebier, Deluc, Gabriel Cramer, Ch. Bonnet, Ed. Claparède, etc., without mentioning our contemporaries—certainly worthy of their predecessors.

The Confederates, or Swiss of other cantons residing in Geneva, are politically akin to the masters of the country, so they pay with them all taxes and enjoy all privileges. They have the same political status, but though eligible to the Grand-Conseil they naturally enough cannot aspire to occupy the places of highest honour. This part of population does increase, but very slowly; in 1900 they were 26, and now they are 27 per cent. of the total. They come in from almost all the cantons, but especially from Vaud, Neuchâtel, Tessin; they bring with them the very happy influence of the great variety of temperament and character that distinguish the Swiss cantons. They are mostly industrious and clever people, engaged in commerce and working in workshops, manufactories, and offices, many having their cantonal speciality: as, for instance, Ticino, building and earthwork; St. Gall, embroideries; Neuchâtel, watchmaking; Vaud, wine-growing; small cantons, wood-carving, etc.

The Foreigners, or aliens, whose number exceeds those of each of two parts of the population separately, and is rapidly increasing, are more or less welcome guests of the canton—more when they have money, less when in place of money they are only rich in advanced subversive ideas prompting them to disorder. A considerable number work and pay all taxes. Among the nearly 60,000 foreigners residing in the canton, there are 57 per cent. Frenchmen, 25 per cent. Italians, 9 per cent.

Germans, about 4 per cent. Russians, about 1 per cent. each of Austrians and English, and the rest are divided among twenty-two other nationalities.

Foreigners who do not exercise any profession have no political status, no taxes, no duties, and consequently they do not share in the honours. They are only asked to behave themselves quietly—a just requirement, but not easily obtainable. There are among the foreigners many very different elements: the idle rich entertaining the flourishing "Industrie de l'étranger," favouring the gambling resorts; the families of moderate resources residing for the education of their children, and sometimes for economy; the pupils of schools, colleges, universities, quietly pursuing their studies; tradesmen, workmen, merchants, professionals, teachers, but also the turbulent youth of political emigrants, discontented workers, unemployed; there are also many poor, who require public assistance, which is a heavy burden for the local exchequer.

Formerly about one-third of the foreigners resided in the country, now only 20 per cent. of the whole remain there, the rest residing in the city and its suburbs. They constitute 16,300 householders (ménages). There are communities (*e.g.* Chêne-Bourg) where the foreigners are more numerous than the Swiss population. The aliens give no small trouble to police and officials; they take an active part in strikes, and they require vigilant supervision to protect the canton from mischief of international character.

The Naturalised.—The conditions for naturalisation are easy; two years of residence, good conduct, and the consent of a commune, which fixes the price. This varies according to some special advantage the commune may offer to its new members, but seldom exceeds 200 francs (£8). The number of aliens annually accepted in the canton on the list of naturalised is increasing. From 752 ten years back, it had risen to 1000 in 1901; and was slightly above that figure in 1907.

The percentage of different nationalities that solicit naturalisation varies from year to year; from 26 to 60 per cent. are Swiss of other cantons; from 26 to 40 per cent. French; about 10 per cent. Italians, and about the same percentage Germans. From 1900 to 1907 there have been about two score of Englishmen naturalised. About half of the Swiss naturalised come from Vaud, 10 per cent. from Berne. In each 100 of naturalised there are on the average 30 adult men, 25 adult women, and 45 children.

Religious Distinctions.—To complicate the matter, there are also great religious distinctions in the canton. Religion has played a very important *rôle* in the history of Geneva. It has rendered to the Republic an immense service, placing it as one of the bulwarks for the defence of the new ideas inaugurated by the Reformation in the sixteenth century; it has powerfully contributed to the emancipation of men's minds from passive obedience; it has sharpened the thinking faculties of the people; it has attracted from France a number of distinguished men; but at the same time it has also created much bad blood, engendered violent struggles and enmities, created much disturbance, injustice, and cruel persecution.

All bad sentiments of enmity and ill-will among the men on account of differences in religious views are not quite extinct even in our days, but there are no more struggles now in Geneva on account of religion; every one is free to confess according to his conscience; there is complete toleration, and there remain only some quiet disputes about the confiscated Church property and some minor matters. Religion in general, of whatever creed, though always the important preoccupation, no longer occupies its former place of pre-eminence, and quite recently by a small majority the people of Geneva voted for the separation of Church and State. The once theocratic Government has henceforth nothing to do with ecclesiastical matters—a huge step in advance from the time when Calvin, a French theologian, in the name of religion and under the sanction of severe penalties gave orders to the "free" citizens of the Republic as to how they were to dress, and what they were to eat or to drink.

This progress is certainly due to the influence of general advance in science, and to a vast obligatory public system of education.

We give in the next table the proportion of different Confessions:

PROPORTION OF DIFFERENT CREEDS.

	Protestants.	Catholics.	Others.
Genevese	30,517	19,120	531
Confederates	29,556	8,045	108
Foreigners	5,973	50,480	2717
	66,046	77,645	3356

There is, therefore, a numerical preponderance of Protestants among the Genevese and Confederates; 61 per cent. in the first case, and 78 per cent. in the second; but almost four-fifths of the foreigners are Catholics, so that already this canton, the former bulwark of Protestantism, has a population more than half Catholic, and this preponderance of the old creed tends rather to increase. This was certainly unexpected by Calvin.

The Unifying Agencies.—That in a social and political body of such very dissimilar elements some harmony may subsist in life and aspirations, it is indispensable to have many ties or unifying and binding factors allowing every unit to co-operate more or less in its own way for the prosperity and welfare of the whole. The chief of these factors are marriage, public and private social life, societies and associations of every kind and nature, and, above all, the school and the newspaper. Social life has mainly a public character, there are almost no rich families willing and able to entertain on the scale of Scottish hospitality. There are certainly numerous small afternoon teas for ladies, there are

small family gatherings on festival occasions, but the balls and numerous assemblies are organised mostly by national fractions of University students and alien colonies. On the contrary, the associations are very numerous and varied. There are political circles, working syndicates, commercial and industrial chambers, literary, scientific, professional, religious, temperance, arts, sports, financial, military, gymnastic, shooting, beneficent and many other societies, and associations with a very liberal rule for admittance of all persons native and alien, though, of course, the places of honour on directing committees are reserved mainly to the first. With many exceptions they are small organisations, with very limited financial resources and few actual members, as their very multiplicity is an obstacle to the formation of more powerful bodies; yet all these notwithstanding, these associations are of great importance as allowing everybody, old and young, partner and worker, artist and amateur, to pursue their callings and occupations or sports under the most favourable auspices and protection.

The School.—The efforts of people and authorities in connection with public education are quite remarkable; in this respect Geneva, like the whole of Switzerland, must be placed in foremost rank among the nations, and certainly the instruction given nowadays may be considered as the most potent agent in social progress and evolution. With a population of 145,000 the canton expends for public instruction 4,109,270 francs (£164,400), in which sum 249,322 francs enters as a Federal subsidy. It is about the fourth of the budget, and 28 francs (more than a pound) per head of the population. That exceeds considerably the expense for instruction by all other States, and is certainly one of the most happy consequences of the relatively moderate sacrifice the Swiss are called to make for their armaments. In the public schools of the canton there are 22,800 pupils, of whom 8788 are foreigners. The secondary and special schools are frequented mostly by children of the natives. The University has about seventeen hundred students, of whom 32 per cent. are ladies and 80 per cent. foreigners (mostly Russian and Bulgarian).

There is also a considerable number of voluntary schools. Primary education is gratuitous and obligatory for all children of both sexes from six to fourteen years, without exception of foreigners. This involves on the part of the canton a very considerable sacrifice of more than one million francs (1,085,608) £43,424, without considering the interest of the outlay on the numerous and palatial school buildings constructed partly on their account. The education is secular; religious instruction is given outside.

It is just to recognise that no other State in the world with such very limited means incurs such sacrifices for the mere sake of enlightening humanity and preventing the evils which result from the presence in the social surroundings of ignorant, unoccupied children. The physical development of the population, however, is not quite satisfactory, there being only 52 per cent. returned as capable of the total number of young men liable to military service.

Besides the schools and University, with ample provision for the

education of children and young people, a series of popular public lectures in town, as also in the country, are organised for adults.

There is also a very active, well informed, well conducted, and honest Press of all political tendencies, from conservative to anarchical and subversive, from religious to irreligious, interesting itself in local as well as in universal affairs, especially those which regard neighbouring states—France, Italy, Germany. Some of the Genevese periodicals, as for instance the *Journal de Genève*, have acquired a universal renown.

The numerous libraries in Geneva are well stocked, and there are also some excellent publishers.

(To be continued.)

BATHYMETRICAL SURVEY OF THE FRESH-WATER LOCHS OF SCOTLAND.[1]

Under the direction of Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., etc., and LAURENCE PULLAR, F.R.S.E.

PART XIII.—LOCHS OF THE NESS BASIN.

SECOND PART.

THE first part of this paper[2] dealt with the physical features of Loch Ness, and in this second part it is proposed to describe twenty-seven of the tributary lochs. The remaining five lochs will be treated of in a third part, which will also include some general notes on the temperatures and seiches observed in Loch Ness, on the deposits covering the floor of Loch Ness with chemical analyses of some selected samples, on the biology of the lochs within the Ness basin, and on the geology of the district.

Loch Quoich.—The largest loch in the basin after Loch Ness. It is very nearly 7 miles in length, and occupies the upper part of Glen Garry, which here runs east and west. It is 9 miles west of Loch Garry, and 15 miles from Loch Oich. It is much nearer the west coast, the head of Loch Hourn being only 4 miles distant. The mountain peaks both north and south reach well over 3000 feet. On the south the highest peak is Sgor Mor (3290 feet). On the north the two peaks of Sgurr a' Mhoraire (3365 feet) and Gleourach (3395 feet) rise to the west and east of Glen Quoich, which branches northward from Glen Garry about the middle of Loch Quoich. On the north Loch Quoich is densely wooded for the greater part of its length.

Loch Quoich is of the usual elongate form of Scottish glen lochs.

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[1] Abbreviated from a paper published in the *Geographical Journal* for October 1907, with maps and figures.

[2] P. 187.

Its central line is strongly curved, the central part further north than the ends. The height of the loch above sea-level on May 6, 1903, was 556·0 feet; the Ordnance Survey officers, on August 24, 1867, found it to be 555·3 feet. The length, measured in a straight line between the ends, is almost exactly 6 miles; measured along the centre line it is nearly 7 miles. The maximum breadth of three-quarters of a mile occurs just east of the centre. The mean breadth is a little under half a mile. The superficial area of the loch is about 1833 acres, or fully $2\frac{3}{4}$ square miles, and it contains 8345 millions of cubic feet of water, more than twice the volume of Loch Garry, the loch next to it in size.

Loch Quoich drains an area of 49 square miles, which includes no large lochs, but some very small ones which were not surveyed. Several large burns, rising among the high mountains of the west, enter at the head of the loch, and the Caolie Water, flowing in on the north shore, is a fair stream; but the most important inflowing river is the Quoich, which enters about the middle of the north side, and has here by its delta effected a considerable narrowing of the loch. The constriction so produced is the greater because, just opposite the mouth of the river, a high promontory juts out more than a quarter of a mile from the south shore. The shallowing of this constriction is but slight.

The basin of Loch Quoich is simple, with steep and nearly uniformly sloping sides, and very little flat bottom. The contours are all continuous and approximately parallel with the shore-line, except the 200-feet contour, which is slightly interrupted by a shallowing where the maximum is 190 feet, just west of the mouth of the Quoich. The area of over 200 feet to the west of this is three-quarters of a mile long, and has a maximum depth of 220 feet. The larger area of over 200 feet is 2 miles long, and extends from just west of the narrows eastward. The area of over 250 feet lies well down the loch, coming to within $1\frac{1}{2}$ miles of the outflow, and includes the maximum depth of the loch, 281 feet. The mean depth of the loch is $104\frac{1}{2}$ feet. The proper basin of the loch terminates three-quarters of a mile from the lower end of the loch. At this point there is a bend at right angles to the main axis, and there extends a broad, tortuous, shallow section of the loch, with a greatest depth of only 43 feet, and numerous small islands.

As is shown by the narrowness of the areas enclosed by the deeper contours, there is no marked indication of the U-shaped section of valley lochs excavated by glaciers. The promontory opposite the river Quoich, occurring where a great bend of the axis takes place, must have caused a narrowing here before the delta of the Quoich was laid down.

On May 6, 1903, the difference of temperature between the surface and 150 feet was under 1°:—Surface, 41·9° Fahr.; 50 feet, 41·2°; 150 feet, 41·0°.

Loch Poulary.—A long, irregular, narrow loch running east and west in Glen Garry, between Loch Garry and Loch Quoich, about 4 miles distant from the former and 2 miles from the latter. It is little more

than a series of expansions of the river Garry, and its limits are accordingly not easy to define. The portion surveyed begins at Eilean Dubh, extends eastward for 1 mile as a narrow channel varying from 9 feet to 23 feet in depth, and then expands into a little basin half a mile long by one-fifth of a mile in greatest breadth. The length of the whole loch is $1\frac{1}{2}$ miles, and the mean breadth one-tenth of a mile. The area of the surface is about 91 acres, and the drainage area, which includes Loch Quoich, is 82 square miles. The volume of water is 39 millions of cubic feet. The Allt a' Ghobhain, a considerable stream, and some small burns, enter on the north shore. From spot-levels on the shores, the height of the loch above the sea was estimated to be 320 feet. The greater part of the loch is shallow, but in the eastern basin there is deeper water in the centre, forming, however, only a narrow channel. The maximum depth is 47 feet, the mean depth 10 feet.

There was a difference of only 1° in temperature between the surface (53·8° Fahr.) and a depth of 40 feet (52·8°) on September 28, 1903.

Loch Garry.—Loch Garry is one of the most important lochs in the basin, being inferior in size only to Loch Ness and Loch Quoich. It occupies the lower part of Glen Garry, and its lower end is only about 3 miles west of Invergarry on Loch Oich; its direction is about due east and west. Glen Garry is at this part very open, the high hills, Ben Tee, a conspicuous pyramidal hill 2936 feet in height, on the south, and Meall Dubh (2581 feet) and some lesser peaks on the north, being several miles distant. The sides of the valley rise gradually to the mountains, the lower slopes on both shores of the loch being densely wooded.

Loch Garry is elongate, slightly curved, of nearly uniform breadth for the greater part of its length, but in the eastern part for a mile very irregular and shallow. Its length is 5 miles, its greatest breadth fully half a mile, and its mean breadth one-third of a mile. Its superficial area is about 1117 acres, or $1\frac{3}{4}$ square miles, and its contents 3794 millions of cubic feet. The drainage area, including Lochs Quoich and Poulary, is 137 square miles. Besides the river Garry, which enters the loch at the west end, some large streams, coming down from the mountain-mass to the westward of Ben Tee, enter on the south, and many smaller streams on the north. Leaving the loch, the river Garry flows 3 miles to the east and enters Loch Oich at Invergarry.

Loch Garry, at the date of the survey (May 2, 1903), was 257·0 feet above sea-level; the Ordnance Survey officers on July 2, 1869, found the elevation to be 257·8 feet above the sea.

In the character of its basin Loch Garry closely resembles Loch Quoich, higher up in the same glen. The main part of the loch, fully $3\frac{1}{2}$ miles long, is a simple basin. As in Loch Quoich, there is a large portion at the east end, one mile in length, which is quite distinct from the basin, and is of moderate depth.

This eastern part is cut off from the main loch by a large, low, wooded promontory, called the Garbh Eilean (Rough island), and a sandy island (Eilean Bàn), to the south-west of it. An irregular

channel, varying from 9 feet to 18 feet in depth, leads to the small eastern basin, which has a small island at each end, and a narrow arm running to the north. This basin has a narrow area half a mile long, over 25 feet in depth, with a maximum depth of 43 feet. At the west end of Loch Garry a narrow offset runs for half a mile westward, with a depth of 5 feet at the mouth, and of 8 to 16 feet within.

The main basin shallows greatly towards each end. The 50-feet and 100-feet contours closely follow the shore, except at the ends. The 150-feet contour encloses but a narrow area $1\frac{3}{4}$ miles long. This is a good deal nearer the south shore in the greater part of its length, but for half a mile at its west end it recedes far from the south shore, where the slope from 100 to 150 feet is very gradual. A small isolated 150-feet area, based on a sounding in 159 feet, lies to the east of the main 150-feet basin, the deepest sounding in the short interval between them being 146 feet.

Centrally, in the length of the loch, but nearer the south shore, is a small area a quarter of a mile long, over 200 feet deep, with the maximum sounding of 213 feet. The mean depth is 78 feet. The contours show that the slope of the bottom is nowhere very steep, but is steepest on the south side at the deepest part of the loch. There is but little extent of flat bottom at depths of over 150 feet, but where the depth is less than that, especially towards the west end, there is a well-marked flat with steeper sides.

The temperature at the surface was 42·4° Fahr., and at 170 feet 41·8°, a difference of only 0·6°.

Loch a' Bhainne.—A very little loch, high up on the hill to the north of Loch Garry, about 2 miles north of the east end of that loch. It is roughly triangular, with the apex to the south. The hills rise steeply from the loch to the west and north. It is fed by streams coming from Màm a' Chroisg, and the Allt a' Bhainne flows south-eastward 3 miles into the river Garry. The bottom is irregular, the greater part covered by less than 10 feet of water, but there are two holes of over 20 feet, the larger with the maximum of 28 feet close to the east shore, the other with a depth of 27 feet to the south; a sounding of 13 feet between the two.

It is one-third of a mile long, a quarter of a mile in greatest breadth, and one-seventh of a mile in mean breadth. The mean depth is 10 feet. The superficial area is about 32 acres, and the volume 14 millions of cubic feet. The drainage area is nearly 2 square miles. The height above sea-level was estimated at 1060 feet. The temperature at the surface and at 20 feet was 45·0° Fahr. on May 5, 1903.

Loch Lundie (by Garry).—A small loch in Glen Garry, on a tributary of the river Garry, about $1\frac{1}{2}$ miles north-west of Invergarry, on Loch Oich. It is of irregular form, its outline broken by various arms and promontories. A point on the west side, with an island off the east shore (Eilean na Faoileige), cause a narrowing and separate two expansions. From the northern expansion several narrow arms run north-eastward. Loch Lundie is three-quarters of a mile long, by fully one-

third of a mile in maximum breadth, with a mean breadth of one-fifth of a mile. The surface has an area of about 109 acres, and the volume of water is 78 millions of cubic feet. The drainage area is about 3½ square miles. The Allt Lundie comes in on the west, and the Aldernaig Burn, soon joined by the Allt a' Bhainne from Loch a' Bhainne, flows south into the river Garry. The height above sea-level, measured by the Ordnance Survey on August 18, 1869, was 445·4 feet.

The contour of the bottom is very uneven. The 20-feet contour enters both expansions, keeping closer to the west shore. In both of the expansions there is a depth of 30 feet close to the west side. The deepest water in the loch is close off the promontory on the west shore and nearly in the narrows. Here is a little area over 40 feet deep, with the maximum of 54 feet. Rock was seen at a number of points on the east and south. There are several small islands, and one of these, north of Eilean na Faoileige, is of rock.

The temperature on May 5, 1903, was almost uniform throughout—at the surface, 46·5° Fahr.; at 40 feet, 46·5° Fahr.; and at 50 feet, 46·6° Fahr.

Loch Oich.—An insignificant loch in point of size, though of considerable length, Loch Oich is commercially important, as it forms the highest portion of the Caledonian Canal. As regards length, it comes fifth in the Ness basin, if we exclude the artificial Loch Mhor.

Loch Oich is an exceedingly narrow, straight loch, with its long axis running nearly south-west and north-east. High hills rise on the east, and the dense woods which clothe the west shore, with the islands on its surface, render Loch Oich extremely beautiful.

Loch Oich is 4 miles long, and has a maximum breadth of little over a quarter of a mile, and a mean breadth of barely one-fifth of a mile. The superficial area is about 489 acres, or three-quarters of a square mile, and the contents amount to 890 million cubic feet of water. This is about one-half the volume of Loch Clunie, a loch very little longer, and only one-fourth the volume of Loch Garry.

The drainage area of Loch Oich, including as it does Lochs Quoich and Garry, is very large, amounting to 170 square miles. The drainage is brought chiefly by the river Garry, which enters the loch about the middle of the west shore. Only little hill-torrents come in on the east. The out-flowing river Oich runs 4 miles north-east to Loch Ness. The level of the loch on May 1, 1903, was found to be 106·0 feet above sea-level; on the Ordnance Survey map the level is given as 104·8 feet above the sea, but the date on which the observation was made is not indicated.

The outline of Loch Oich is constricted at several points, first at Ardrishaig, half a mile from the south end, again a mile further down the loch, and again at the mouth of the Garry, where a great peninsula has been made by the river, and opposite to it long narrow islands. From the mouth of the Garry the width increases to near the overflow. A great part of the loch, equal to 68 per cent. of the entire area, is less than 50 feet in depth. The central part of the loch is shallowest.

Opposite the mouth of the Garry the greatest depth is 20 feet, close to the island. There are four areas of over 50 feet. The first of these is close to the north-east end of the loch. It is three-quarters of a mile long, and encloses an area half a mile long over 100 feet in depth. Near the south-west end of this 100-feet area is the maximum depth of the loch, 154 feet, and near the other end of the area there is a sounding of 129 feet, with a depth of only 108 feet between them. The second 50-feet area is half a mile south-west of the river Garry, and is marked by an isolated sounding of 57 feet. The third 50-feet area begins half a mile from the south-west end, and extends down the loch for a mile. It is the largest basin in the loch, but not so deep as the more northerly one, the greatest depth in it being 133 feet. The fourth 50-feet area is close to the upper end of the loch. It is one-third of a mile long, and is scarcely separated from the larger one, as they are close together, and the depth between is 48 feet. In this fourth basin the greatest depth is 84 feet.

A series of temperatures taken in May shows a range of barely 2° from surface to bottom, while a series taken in September shows a range of over 6°, a fall of 2° having been recorded between 90 and 100 feet. The whole body of water was warmer in September than it was in the preceding May, the bottom reading in September being 4° higher than the surface reading in May, while the difference between the two bottom readings is about 6°, and between the two surface readings about 10°.

Loch Uanagan.—Loch Uanagan lies a little more than a mile to the south of Fort Augustus, on Loch Ness. It is a narrow little loch lying parallel to the Caledonian Canal, which is one-third of a mile to the west, and is separated from Loch Uanagan by the Torr a Choiltry, a high ridge with steep sides, densely covered with fir-trees. This hill rises abruptly from the west side of the loch to a height of 384 feet, some 266 feet above the surface of the water.

Loch Uanagan is half a mile long, and has a maximum breadth of one-eighth of a mile. The superficial area is about 25 acres, and the volume of water 18 millions of cubic feet. The drainage area is about $1\frac{1}{4}$ square miles. The only stream of any size flows in at the south end, and near the north end a small burn flows out to the east, where a small part of the loch has been cut off by the railway, and joins the river Tarff half a mile to the north. The height of the loch above sea-level on July 2, 1903, was 118·2 feet.

Loch Uanagan is very shallow, the greater part of it less than 10 feet deep. Only one-fifth of the area is over 25 feet in depth, the 25-feet contour enclosing a narrow area one-sixth of a mile long, nearer to the east shore, and the maximum depth of 43 feet is near shore, the slope here being steep. The steep slope of the hill on the west is not continued under water, the loch on that side being shallower.

The surface temperature on July 2, 1903, was 63·0° Fahrenheit.

Loch Bay (by Clunie).—A small triangular loch about a quarter of a mile west of the upper end of Loch Clunie. It is simply an expansion of the river Clunie, and is at the same level as Loch Clunie. It is one-

third of a mile long by one-fifth of a mile broad. The area of the surface is about 26 acres and the drainage area very extensive, viz. 20 square miles. The volume of water is 13 millions of cubic feet. The basin of Loch Beag is simple, the sides gently sloping, the greatest depth, 29 feet, in the centre of the loch. The channel connecting Loch Beag with Loch Clunie varies in depth from 11 feet to 23 feet.

Loch Clunie.—Loch Clunie (or Cluanie) is a large loch occupying Glen Clunie, which runs east and west, and is the source of the river Moriston. The lower end is about 16 miles distant from Invermoriston, on Loch Ness. The upper end is some 13 miles from Sheil bridge, at the head of Loch Duich, on the west coast, but Loch Hourn is still nearer, only 10 miles as the crow flies. High mountains rise on both sides of the loch, those on the south reaching nearly 2500 feet, while on the north the highest peak, Sgurr nan Conbhairean, 2 miles distant, is 3632 feet in height.

Loch Clunie is very narrow, $4\frac{1}{4}$ miles in length, and its central line has a slight sigmoid curvature. The shore-line is very irregular, and the width varies greatly at different parts. Widest in the upper part, where the maximum breadth of half a mile occurs at two points, at the extreme west end, and $1\frac{1}{4}$ miles further east, whence the loch narrows greatly toward the east, till about a mile above the outflow the width is only one-fifteenth of a mile. Beyond this narrow part it expands into a distinct small basin nearly a quarter of a mile in breadth. The mean breadth of the entire loch is just about a quarter of a mile. The superficial area exceeds 1 square mile (about 704 acres), and the drainage area, which includes no other lochs except Lochs Beag and Lundie, is 32 square miles. It is fed by the river Clunie and some large burns on the north shore, very little water entering on the south shore, except the surface drainage. The river Moriston flows out from the east end of the loch. Considering the volume of water, which amounts to 1533 millions of cubic feet, Loch Clunie comes fourth in point of size in the Ness basin (including Loch Ness). In point of length it comes fifth, as Loch Mhor is about half a mile longer, though in volume about 400 million cubic feet less, than Loch Clunie.

The level of Loch Clunie on September 29, 1903, was 605·2 feet above the sea; the Ordnance Survey officers on October 5, 1867, found the level to be 605·9 feet. The water might rise 4 feet above the level on the date of the survey. Above the narrows, 1 mile from the east end of the loch, which cut off a small basin exceeding 50 feet in depth, the basin of Loch Clunie is a simple one. The 25-feet contour closely follows the shore-line, and the 50-feet contour is nearly parallel to it, but much closer on the north, where the slope is steeper. The 100-feet contour is parallel with the others, and encloses a relatively large area, nearly $1\frac{1}{2}$ miles long by a quarter of a mile in greatest breadth. It is broken into two parts by an unimportant shallowing of 98 feet. The smaller western portion has a maximum depth of 119 feet; the greater area has a maximum of 123 feet. The mean depth is 50 feet. In the narrows the depth at the western end is 10 feet, and at the eastern end

only 6 feet, while halfway between is a hole of 23 feet. The small basin to the east of the narrows is on the whole shallow. Almost in the centre is a shoal where the depth is only 2 feet, and close to this, on the north, is a sounding of 30 feet. The greatest depth in this basin, 53 feet, is between the shoal and the narrows.

Consideration of the contours and the nearly flat bottom shows that there is the U-shaped section associated with glacier-hollowed lochs, though, on account of the moderate depth, it is less clearly defined than in many other large lakes.

A series of temperatures taken in the deep part of the loch showed a uniform reading of 51·8° Fahr. at all depths from 10 feet to 75 feet. The bottom at 100 feet was a little cooler (51·2°), and the surface a little warmer (52·0°), the total range being thus 0·8°.

Loch Lundie (by Clunie).—A small triangular loch lying immediately to the north of Loch Clunie, about equally distant from either end. The long axis runs nearly east and west, and the greatest breadth is towards the west end. The outline is very irregular, and there are several small islands near the shore.

The height above sea-level on September 30, 1903, was found to be 681·5 feet, some 76 feet above Loch Clunie; the Ordnance Survey officers on August 2, 1869, found it to be 681·9 feet. The length is little under half a mile, and the greatest breadth one-fifth of a mile. The superficial area is about 27 acres, the drainage area nearly 1 square mile, and the contents amount to 9 millions of cubic feet. It receives only some small burns, and is drained by a burn issuing from the south-west corner flowing south a quarter of a mile into Loch Clunie.

Loch Lundie is of no great depth, three-fourths of the superficial area being covered by less than 10 feet of water. The area more than 10 feet in depth is narrow, and passes obliquely across the loch. The greatest depth of 25 feet occurs at the extreme east end of this area, and near shore, in a narrow part of the loch.

The temperature on September 30, 1903, was the same at the surface and at 20 feet, viz. 54·0° Fahr.

Loch Loyne.—The two lochs under this name consist of a chain of little basins or expansions of the river Loyne, connected by narrow channels. The valley of the Loyne lies halfway between Glen Clunie and Glen Garry, which are 2 or 3 miles distant. On the north the lochs are separated from Loch Clunie by Beinn Loinne, 2500 feet in height. The hills on the south, though wild and bleak, are not so high. The main road from Tomdoun to Clunie Inn crosses between the two lochs. The valley to the west of the road has an east-and-west trend, but from the bridge through the east loch to Glen Moriston it runs nearly due north-east. The east loch is much the longer, and is also deeper.

The West Loch.—The west loch lies at a height of 719·0 feet above the sea. It is 1¼ miles in length, with a maximum breadth of fully one-third of a mile, and a mean breadth of one-fifth of a mile. It consists of three expansions, all running south from the connecting

channel, or, in other words, the north shore is unbroken, but two promontories break the south shore, separating the loch into three bays. The west bay is extremely shallow, with a maximum of 6 feet. Two islands lie off the mouth of the river, and round these and to the north the loch is overgrown with weeds. The channel joining it with the mid bay has a minimum of 5 feet, but deepens to 9 feet in the east. The mid bay has also a maximum of 6 feet. The channel leading east from it is 12 feet deep. The eastern expansion deepens from west to east, the maximum of 19 feet being close to the shore. The area of the surface is about 153 acres, or a quarter of a square mile, and it receives the drainage of 16 square miles. It contains 40 million cubic feet of water. The river Loyne, of which the loch is merely a series of expansions, conveys the overflow to the east loch, half a mile distant and about 13 feet lower.

The surface temperature on May 4, 1903, was 47·7° Fahr., the air temperature at the same time being 47·8°.

The East Loch.—East Loch Loyne is more than twice as long as the west loch, and is also about twice as deep, but it is much narrower. There are four principal expansions. The western expansion is extremely shallow, having a maximum depth of 7 feet, and on the date of the survey, when the river was in flood, there was a strong current through. There is an island about the middle of it. The channel leading to the second expansion has a depth of 5 to 9 feet. The second expansion is very small, with a maximum depth of 21 feet, and is joined with the third basin by a channel 5 feet deep. The third basin is much the largest, and has more claim to be called a loch, being $1\frac{1}{4}$ miles in length, with a maximum breadth of fully a quarter of a mile, and but for some large and small islands towards the west end, is a simple basin, with contours parallel to the shore. The area over 20 feet in depth is over half a mile long, with depths of 35 feet in two places—the maximum for the whole loch. The easternmost basin is narrow, two-thirds of a mile long, of uneven bottom, with greatest depths of 20 and 21 feet. The length of the east loch, taken in a straight line between the extreme points, is $2\frac{1}{2}$ miles, the greatest breadth is a little over a quarter of a mile, and the mean breadth is about one-seventh of a mile.

The area of the surface is about 272 acres, or nearly half a square mile, the area draining into the loch being about 24 square miles, including the little Loch na Losguinn and West Loch Loyne. The volume of water is 123 millions of cubic feet. The drainage is chiefly brought by the river Loyne, only small burns contributing a share, the largest entering close to the outflow.

The prominent points on both shores, and the large island, are formed by mounds of boulders and gravel. The only rock seen was at the very narrow channel, with a depth of only 2 feet, at the east end of the largest basin. Here rock was exposed on both sides. The river flows out between an alluvial flat on the north and mounds of glacial débris on the south. The height above the sea was 706·1 feet on November 4, 1904.

The temperature of the surface was 46·6 Fahr., and at 30 feet 46·2°, the air temperature at the same time being 48·0°.

Loch an Staca.—Loch an Staca is a considerable minor loch, of roughly triangular form, situated on the extensive elevated area which stretches westward from Loch Ness, between Glens Moriston and Urquhart. It is 6 miles distant from Loch Ness. Its longer axis lies nearly north-east and south-west. The undulating moorland rises little above the loch, except on the east, where Meall na Criche, 2224 feet in height, sends a long ridge southward between Lochs an Staca and na Criche.

Loch an Staca is estimated to be 1600 feet above the sea. It is a mile long by two-fifths of a mile broad, with a mean breadth of a quarter of a mile. The superficial area of the loch is about 163 acres, or a quarter of a square mile, and the drainage area $1\frac{1}{4}$ square miles. The volume of water is 110 millions of cubic feet.

Loch an Staca receives only local surface drainage, and the overflow is carried into Loch Liath by a small burn. The bottom is very uneven, a depth of only 9 feet being found almost in the centre of the loch, with deeper water on all sides. There is a small island close to the west shore. A great part of the bottom, equal to 74 per cent. of the total area, is covered by less than 20 feet of water. Four little depressions occur. The deepest, with the maximum depth of 51 feet, is close to the east shore; another of 32 feet lies to the south-west of this; one of 30 feet close to the west shore, north of the island; and one of 30 feet in the centre of the loch, near the north end. At this end is another island. The mean depth is $15\frac{1}{2}$ feet.

The surface temperature (June 2, 1904) was 56·5° Fahr.; at a depth of 25 feet it was 52·0°, at 50 feet 48·9°, a total range of 70·6°.

Loch Liath.—A little roundish loch about a mile to the south of Loch an Staca, on the same plateau. It is about 100 feet lower than Loch an Staca, the drainage from which it receives. The axis of the loch has a north-east and south-west direction. It is barely half a mile long by fully a quarter of a mile broad, with a mean breadth of one-fifth of a mile. The superficial area is about 61 acres, and its contents amount to 62 millions of cubic feet. The drainage area, which includes Loch an Staca, is 4 square miles. Beyond the burn from Loch an Staca, and another from the hill (2222 feet) on the west, it receives only superficial drainage. The burn Allt Bhlair flows out to the south-east, and joining that from Loch na Criche, enters the river Moriston. The basin is quite simple, the deeper water nearer the south-east side, and the maximum depth of 55 feet towards the north-east end.

When surveyed on June 10, 1904, the level was found to be 1494·1 feet above the sea, which differs little from the level determined by the Ordnance Survey officers on May 15, 1869, viz. 1494·4 feet.

The surface temperature was 56·9° Fahr.

Loch nam Breac Dearga.—Situated on the high ground to the west of Loch Ness, about $1\frac{1}{2}$ miles distant from the middle part of that loch. It lies close to the west of Meall Fuarvounie (2284 feet high), which

separates it from Loch Ness. The loch is elongate, lying nearly north-east and south-west, and of irregular form, roughly oblong. The surrounding moorland rises little above the loch, except on the east, where the crags of Meall Fuarvounie rise close beside the loch.

This loch was locally reputed to be of great depth, or even supposed to be bottomless. Though we found it to be the deepest loch in this elevated tract between Glen Urquhart and Glen Moriston, its depth was not remarkable, and not greatly in excess of that of Lochs Liath and an Staca in the same district. It is three-quarters of a mile in length, about one-fifth of a mile in greatest breadth, and one-eighth of a mile in mean breadth.

The superficial area is about 56 acres, and drains about two-thirds of a square mile. It contains 60 million cubic feet of water. It is drained by a burn running some 2 miles south-westward, into the Allt nan Saighead (Alltsigh), which also receives the overflow of a host of little lochs, which were not surveyed, and runs into Loch Ness. The height above the sea was estimated at 1570 feet.

The basin is simple, but deepest towards the upper or north end. The lower portion is all under 25 feet in depth. The areas of over 25 feet and over 50 feet pass obliquely across the loch from south to north. The 50-feet contour encloses a narrow area, about a quarter of a mile long, with the deepest sounding, 70 feet, in the middle of the loch, but nearer the north end.

The surface temperature on June 1, 1904, was 52·9° Fahr.; at 10 feet, 52·7°; at 25 feet, 48·2°; at 60 feet, 46·2°, giving a total of 6·7°, the greatest fall being one of 4·5° between 10 and 25 feet.

Loch a' Vullan.—A little loch of triangular form, in the elevated hilly country to the west of Loch Ness, and about 6 miles distant from that loch. It is surrounded by moorland, rising but little above the surface of the loch, except on the south, where Meall na Criche rises in a series of low crags to the height of 2224 feet, nearly 500 feet above the loch. The main part of the loch is triangular, with the apex to the north. From the south-west corner an offset runs one-eighth of a mile to the west, narrow at its beginning, and then expanding. The triangular body of the loch is three-eighths of a mile in length, but the greatest length, from the apex to the end of the west offset, is rather more (nearly half a mile). The maximum breadth in the triangle is one-sixth of a mile, the mean breadth one-tenth of a mile. The height above sea-level was estimated from spot-levels to be about 1750 feet.

Loch a' Vullan receives the overflow of a chain of four small lochs, lying to the north-east. The outflow, controlled by a sluice, is by a small burn, going through a chain of small lochs into the river Enrick. The superficial area is about 28 acres, the drainage area two-thirds of a square mile. The volume of water is 15 millions of cubic feet.

There are two basins in Loch a' Vullan. The larger one forming the triangular part of the loch is simple, with the contours following the shore, the greater part less than 20 feet in depth, the maximum depth being 27 feet. In the narrows separating the small western basin

the depth is 13 feet, and in the basin itself 21 feet. The mean depth is 12 feet.

On June 2, 1904, the temperature at the surface was 54·9° Fahr., and at 20 feet, 50·0°.

Loch Meiklie.—A loch of moderate size and relatively broad, situated in Glen Urquhart, about halfway from Loch Ness to Strath Glass, from each of which it is 5 miles distant. Glen Urquhart is a fertile and well-wooded valley. Both north and south of the loch the hills are densely wooded. On the north they rise gradually to over 1000 feet, while on the south they are steeper, and heights of 1700 feet and upwards are reached little more than a mile from the loch. The long axis runs nearly east and west; the length is just over a mile, and the maximum breadth, towards the west end, is nearly half a mile, the mean breadth being over a quarter of a mile. The maximum depth, which coincides with the maximum breadth, is 45 feet, and the mean depth 22 feet.

The area of the surface is about 200 acres, or nearly one-third of a square mile, the drainage area relatively very great, amounting to nearly 42 square miles, and including many small lochs, of which only Loch a' Vullan was surveyed. The river Enrick is the only important stream flowing into Loch Meiklie, and the outflowing river, still bearing the same name, flows into Loch Ness in Urquhart bay. The surface of the water on October 3, 1903, was 364·9 feet above the sea; on June 22, 1867, the Ordnance Survey officers found it about 6 feet higher (371·5 feet).

In form Loch Meiklie is approximately oblong. A shallow inlet, formed by the encroachment of the river, runs one-sixth of a mile from the west end. The basin is quite simple, with the slopes everywhere gentle, but steepest towards the north shore at the deepest part. Over one-half of the whole area is less than 20 feet in depth. The volume of water is 193 millions of cubic feet, making Loch Meiklie the ninth in point of bulk in the Ness basin.

The surface temperature on October 3, 1903, was 53·6° Fahr., the air temperature at the same time 51·0°.

Loch Aslaich.—An extremely beautiful little loch, about 5 miles west of Loch Ness, surrounded by hills of considerable height, rising to about 2000 feet in the immediate neighbourhood of the loch. On a picturesque wooded island in the loch the members of the Lake Survey had their abode (in a lodge kindly lent by the proprietor), while the lochs of the district were being examined. In form the loch is a narrow oblong, with its long axis running north and south. It is one-third of a mile long, with a maximum breadth of one-seventh of a mile. Its superficial area is about 21 acres (only Lochs Dubh and nan Losganan being smaller), and it drains an area of nearly 2 square miles. This area includes a larger loch (Loch nam Meur), which was not surveyed. Besides the chief feeder, the burn coming from Loch nam Meur, two small burns enter the loch. The river Coiltie has its origin in Loch Aslaich, and

flows into the Enrick just where it enters Loch Ness. Its volume is 10 millions of cubic feet; in this respect Lochs Lundie (by Clunie), Laide, Dubh, and nan Losganan, are smaller. The height of the loch above the sea was estimated at 1310 feet. Fully half the superficial area is covered by less than 10 feet of water. The area of more than 20 feet in depth forms a narrow strip along the west side. This comes very near to the south end, and the deepest sounding, 26 feet, is quite close inshore. The mean depth is 11 feet.

On July 2, 1904, the temperature at the surface and at 6 feet was 60·0° Fahr., and at 18 feet, 56·3°.

Loch Dubh.—A very little lochan a couple of miles to the west of Loch Ness and 4 miles south of Glen Urquhart. The shortest loch in the basin, but in all other dimensions the second smallest, since Loch nan Losganan is shallower, narrower, of smaller area and volume. It is obscurely triangular in form, its axis running south-west and north-east, the apex to the north-east. It is situated at a high level, estimated at 1340 feet, amid moorland, rising gradually southward to Meall Fuarvounie (2284 feet). It is nearly one-fifth of a mile in length, and one-ninth of a mile in greatest breadth. It is only about 8 acres in area, and drains an area of over 100 acres. Its volume is 2 millions of cubic feet, twice that of Loch nan Losganan. It drains by a small burn into the river Coiltie. The basin is simple, with evenly sloping sides, and the deepest sounding of 18 feet almost in the centre.

Loch Laide is a little shallow round loch, measuring just about one-third of a mile in diameter, lying at a considerable elevation among the hills to the west of Loch Ness, near its northern end, above Abriachan, and about 1½ miles distant. It is surrounded by moorland and low hills, rising on the south side nearly 600 feet above the loch (Carn an Leitire, 1424 feet), within a distance of half a mile. There is no bench-mark nearer to the loch than the summit of this hill. On August 4, 1869, the Ordnance Survey officers found the height above sea-level to be 859·8 feet.

The superficial area of Loch Laide is about 39 acres, and it drains an area of 1½ square miles. It has a volume of water of 9 millions of cubic feet, only two lochs in the Ness basin (Lochs Dubh and nan Losganan) being less in volume. It is fed chiefly by one small burn, rising some 2 miles to the south-west, and the overflow is carried by the Allt Loch Laide into Loch Ness at Abriachan. The bottom of Loch Laide is very uneven. The greatest depth, 9 feet, is found close to the east shore. In the centre the depth is only 4 feet, and other soundings of 3 and 4 feet are found far out. There are low islands near shore to the south and west. The mean depth is just over 5 feet, or fully half the maximum depth.

The surface temperature on May 20, 1904, was 52·3° Fahr.; at 5 feet, 51·7°; and at 8 feet, 51·3°.

Loch Tarff.—Loch Tarff is a beautiful loch of triangular form lying

high among the hills to the east of Loch Ness, from which it is about a mile distant, and 3 miles north-east of Fort Augustus. There are several large and small islands, some of which are covered with trees. Rocky hills rise on all sides, but to no great height above the loch in the immediate neighbourhood. Beinn a' Bhacaidh (1813 feet) on the north is 850 feet above the loch. The high mountain range, culminating in Corrieyairack, is more distant on the south-east. The outline is almost an equilateral triangle. The shores are undulate. The large Eilean Ban is close to the shore on the north-east. On April 25, 1903, the elevation of the lake-surface was 956·2 feet above the sea, almost identical with that observed by the Ordnance Survey officers on July 17, 1866, viz. 956·3 feet. The greatest diameter measured from north-west to south-east exceeds two-thirds of a mile. The maximum breadth, taken at right angles to the line of greatest diameter, is fully half a mile, the mean breadth being over one-third of a mile. The superficial area is about 131 acres, and the contents 136 millions of cubic feet. The drainage area is rather over 1 square mile. Some small burns come in from the hills to the north, and the overflow is carried into the Doe burn, a mile to the south-west, and so into Loch Ness.

Loch Tarff is shallow. Though it has a maximum depth of 89 feet, the mean depth is only 24 feet, nearly two-thirds of the area being less than 25 feet deep. The bottom is irregular, there being three separate basins over 25 feet in depth. Two of these are unimportant and lie towards the south-east shore, with maximum depths of 27 and 42 feet respectively. The largest 25-feet area lies to the north-west of Eilean Ban, and stretches from south-west to north-east nearly across the loch, with a breadth of one-fifth of a mile. It encloses a small 50-feet area and a very small area of over 75 feet, both to the north of the centre and nearer the north-east shore, the maximum sounding, 89 feet, being found about halfway between the island and a rocky point north-west from it.

Loch Knockie.—A loch of moderate size and very irregular form, about a mile east of Loch Ness, opposite Invermoriston. It is a beautiful loch, with great parts of the shores wooded, and several tree-clad islands. It is narrow, with the axis running nearly south-west and north-east. The shore-line is undulating. A large broad bay runs off to the north-west, and there are several smaller bays on the south-east shore. The length is $1\frac{1}{4}$ miles, the maximum breadth half a mile, and the mean breadth one-fifth of a mile.

The superficial area is about 182 acres, or a little over a quarter of a square mile, and the volume of water 194 millions of cubic feet. It has a very limited drainage area, amounting to only about $1\frac{2}{3}$ square miles. No large stream flows into it, and a short burn carries the overflow into Loch nan Lann. There is no bench-mark near, but a spot-level on the shore indicates that the loch is a few feet less than 700 feet above the sea.

Loch Knockie is on the whole shallow, as indicated by the low mean depth, $24\frac{1}{2}$ feet, and by the fact that two-thirds of the area of the loch

is less than 25 feet deep. Both ends are shallow beyond the two narrows which constrict the loch, the deepest part in the north-east portion being 26 feet, and in the south-west portion 32 feet. Both the narrows are 20 feet deep. The central basin between the narrows is deep, and the 25-feet and 50-feet contours follow the shore and enter the west bay. The greater part of the basin is over 25 feet deep, the 50-feet area being nearly half a mile long, but narrow. The 75-feet basin is based on a single sounding in 75 feet, the maximum depth of the loch.

Loch nan Lann.—A small loch of relatively great depth, situated between Loch Knockie and Loch Ness, joined with Loch Knockie by a short stream a quarter of a mile long. Loch nan Lann lies due north and south, and is narrow towards the north and broad towards the south end. There is a constriction in the middle of the loch, with a small and shallow expansion to the north of it, and a broad and deep basin to the south. The axis of the loch is considerably curved. The east shore is wooded. The length is nearly three-quarters of a mile, the greatest breadth one-third of a mile, and the mean breadth about one-seventh of a mile. The superficial area is about 65 acres, and the contents amount to 105 millions of cubic feet. The drainage area includes Loch Knockie, and amounts to $3\frac{3}{4}$ square miles. It is fed chiefly by the burn from Loch Knockie. The outgoing stream leaves the loch at the north extremity, and flows half a mile north-westwards into Loch Ness.

North of the narrows the loch is deeper close to the west shore, and the greatest depth in this part is 41 feet. South of the narrows the expanded portion is a regular and simple basin. The contours are fairly concentric with the sides of the basin, the slope pretty uniform all round, but rather more gradual from 25 to 50 feet. The narrow 100-feet area is an eighth of a mile long, and is a very little to the south-west of the centre. The maximum depth is 109 feet. The loch is approximately 645 feet above the sea.

The temperature at the surface on April 24, 1903, was 42·0° Fahr.; at 15 feet, 41·8°; at 25 feet, 41·3°; at 50 feet, 41·0°; and at 100 feet, 41·0°, the whole range being one degree.

Loch Kemp.—A small loch east of Loch Ness, 3 miles to the south of Foyers. It is of rather irregular form, roughly oblong, with an arm running off to the north, and bays to the east and west. The shore is entirely of rock, and it is surrounded by low hills. The length is half a mile, the greatest breadth a quarter of a mile, the mean breadth scarcely less (one-fifth of a mile). The superficial area is about 68 acres, and the volume of water 77 millions of cubic feet. The drainage area is $1\frac{1}{2}$ square miles. Two small burns enter to the south and east, and the outflowing stream goes half a mile north into Loch Ness. On April 23, 1903, the loch was 577·8 feet above sea-level; on August 4, 1869, the Ordnance Survey officers found it to be 577·4 feet.

The bottom is flat, with a central depth of 41 feet. The 25-feet contour closely follows the shore, but does not go into the north arm, in which there is an isolated sounding of 25 feet. The maximum of

51 feet occurs in a little hole close to the shore, in the south-east corner of the loch, the mean depth being 26¼ feet.

Temperature of the surface, 42·0° Fahr.; at 25 feet, 42·0°; at 50 feet, 41·8°.

Loch nan Eun.—A dark and desolate tarn lying at the foot of the wild and bare Cairn Vangie. The loch lies in a deep valley, and a boat was with difficulty transported down the steep hill from the road. Glen nan Eun runs here nearly east and west. The Cumrack burn flowing out from the loch runs to the north-east and becomes the river Foyers. The surface is about 915 feet above the sea. The length is barely half a mile, and the greatest breadth about one-sixth of a mile. The superficial area is about 35 acres, and the contents 15 millions of cubic feet. The drainage area is nearly 4 square miles, and the chief feeder is the nan Eun, coming from the south-west.

Loch nan Eun is somewhat oblong, and is a simple basin of no great depth. The slope of the bottom is steeper on the south, and very gentle on the north. The maximum depth of 21 feet is near the south shore; the mean depth is 10 feet.

On April 25, 1903, the temperature at the surface was 42·5° Fahr., and at 20 feet, 42·1°.

Loch Killin.—Loch Killin lies high up among the mountains on the east side of Loch Ness, about 10 miles east of Fort Augustus. It is a narrow loch of moderate size, the valley which it occupies running at that part nearly south to north. On the west the precipitous crags of Creag Acain rise abruptly from the shore of the loch to a height of 1000 feet above its surface. Equally high hills rise more gradually on the east.

Loch Killin is narrow to the north and broadens to the south, the maximum breadth of a quarter of a mile being just a quarter of a mile from the south end. The mean breadth is about one-sixth of a mile. The length is considerably over a mile. The loch has a superficial area of about 130 acres, and contains 137 millions of cubic feet of water. Loch Killin has a large drainage area, extending to 38½ square miles, the river Killin, which enters on the south, bringing the drainage of several large glens. The river flowing out to the north is called the Fechlin, and is one of the chief sources of the river Foyers. At the head of the glen, 6 miles south of Loch Killin, is Loch na Lairige, which was not visited. The height above sea-level is about 1044 feet.

Loch Killin is of very moderate depth, with a flat bottom. More than half the area of the loch (58 per cent.) is covered by less than 25 feet of water. The area over 25 feet in depth is all south of a little rocky point on the west shore, and is fully half a mile long, the contour following the shore closely. The area over 50 feet in depth, a quarter of a mile long, approaches close to the foot of the cliffs on the west, and the maximum sounding of 67 feet is not far from shore. The mean depth is 24 feet.

The temperature on April 24, 1903, was almost uniform throughout—surface, 36·9° Fahr.; 50 feet, 36·8°.

Loch nan Losganan.—A mere shallow pond with a maximum depth of 7 feet. It is narrowly triangular, its axis curved, and is narrow and elongate to the west. It lies about 4 miles south of Foyers on Loch Ness, and is connected by a small burn with the river Foyers. Though from its elongate form it is not quite the shortest in the Ness basin, in all other respects it is the smallest. In length it is nearly one-third of a mile, and its greatest breadth is one-tenth of a mile. The superficial area is only about 7 acres, its volume only 1 million of cubic feet, and its drainage area a quarter of a square mile.

The temperature of the water on April 21, 1903, was 42·8° Fahr.

NEW RAILWAY PROJECTS IN THE BALKAN PENINSULA.

By Ralph Richardson, F.R.S.E.

(With Sketch-Map.)

One of the distinguishing features of modern times is the rapidity and economy of Travel, more particularly by Railways. In ancient days communities were kept apart, and racial feuds were stimulated, by the absence of facilities for easy and frequent communication. Trade was also at a standstill, and intellectual progress was retarded. Thanks, however, to railways, districts which slumbered were aroused to life and energy, commerce and civilisation dispelled ancient animosities, and nations hitherto unknown took permanently their places in the world.

In this *Magazine* for December 1906 I showed the marvellous growth of Railways throughout Africa, a growth by no means at an end, which has converted what was long known as the "Dark Continent" into a continent which may be easily traversed by railway in various directions. By their influence, as much as by any other, the savagery and bloodshed which were the darkest features of Africa have been largely removed, Christianity and Civilisation have taken the place of Idolatry and the Slave Trade, Commerce has discovered wealth greater than the dreams of Croesus, and, under the influence of the *pax Britannica*, new nations are springing up full of the regard for law and liberty which distinguishes the most civilised nations of Europe.

With these facts before us, the thought occurs, If success has crowned the introduction of railways throughout the Dark Continent of Africa, why may we not look for similar results if railways were made throughout that notorious territory of internecine strife which lies to the south-west of the Balkan Mountains? No part of Africa has known more constant bloodshed than this darkest corner of Europe where Slavs, Bulgars, Greeks, Albanians, Vlachs, and Turks have for generations butchered each other, sometimes for religious, sometimes for racial, reasons. Any one reading such a book as Mr. Frederick Moore's *Balkan Trail*[1] must feel that this corner of Europe is a disgrace not merely to Christianity and Mohamedanism but to Humanity itself.

[1] London: Smith, Elder and Company, 1906.

The question therefore arises, As diplomacy has signally failed to put an end to the horrible conditions under which the unfortunate inhabitants of this territory live, might not Railways help to reclaim it and save the lives probably of hundreds every year, besides bringing employment, trade, and prosperity to a country whose resources, if peacefully developed, would well repay the attempt?

Main lines of railway have already been constructed with success. In May 1907 I travelled with comfort and expedition by the "Orient Express" which runs thrice a week from Constantinople, the capital of Turkey, *via* Sofia, the capital of Bulgaria, and Belgrade, the capital of Servia, to Buda-Pest, the capital of Hungary. It was difficult to believe, in passing through the countries just named, that the peaceful scenes of agricultural industry which we witnessed from the railway-carriage windows were anything but emblematic of the past history of the countries traversed, and one hoped that that well-managed railway had had a civilising influence on the region through which it passed. The pity, however, is that this great railway from Constantinople is so isolated, and that branches from it do not run in every direction. One certainly connects Constantinople with Salonica and Monastir; others proceed from Tirnova in South Bulgaria to Burgas on the Black Sea and Tirnova in North Bulgaria; a third branch goes from Sofia to Nikopoli on the Danube; and a fourth from Nish in Servia to Uskub and Salonica in Turkey; but large portions of the great and fertile district in the Balkan peninsula which is under Turkish rule are still without railways, and are the scenes of racial and religious strife which have baffled all the efforts of all the statesmen of the Great Powers of Europe.

Things were in this unhappy condition when, on 27th January last, Baron von Aehrenthal, the Austro-Hungarian Minister of Foreign Affairs, addressing the Austrian and Hungarian Delegations at Vienna, made a statement which resounded throughout Europe by its proclamation of a new departure in administering the Balkan peninsula. This was the abandonment of the *laissez faire* policy which had brought to that peninsula not peace but a sword, and a proposal that, by opening it up in various directions by railways, its discordant populations would be pacified by means of commerce, civilisation, and facilities of travel. Instead of being condemned to reside in isolated districts, where racial and religious feuds were bred by moral stagnation, the inhabitants would travel easily from place to place, would see new and better scenes of life, and would, by acquiring markets for their products, also acquire habits of industry, and a relief from the penury which so often at present crushes and demoralises them.

It is to the credit of Baron von Aehrenthal that his is the first voice of authority which has suggested Railways as a solution of the Balkans problem. His pronouncement is so important, and perhaps for the Balkans so epoch-making, that I translate it in full. He spoke as follows: "True to our policy as regards the Balkans, we do not seek territorial conquest. In the Balkans, our mission is partly one of civilisation, partly one of economy. Our mission is all the more important as the Balkan countries are on the eve of an era of considerable development. The

opening to economic existence of Asia Minor and Mesopotamia will always be considered as an achievement of the spirit of German enterprise. Other great civilised nations work with no less ardour to create new resources in the Ottoman Empire. All these enterprises, which consist chiefly in the construction of new and very important Railway lines—it matters not whether these are to run east and west or north and south—have one aim, viz., to establish by way of Constantinople and the Straits a colossal exchange of economic benefits between East and West. It is evident that, with this view, the countries situated beyond Constantinople are destined to increase in importance. But we are also, by our possession of Bosnia, a Balkan Power, and our sphere and duty are to discern the signs of the times and to profit thereby. I say this foreseeing a policy relating to Railways. By the construction of the eastern railways to the Turkish and Servian frontiers we have laid the foundation for further evolution. We desire above all to act in accord with others. That will not be difficult as regards Servia. The railway line to Varditsa is completed, and the junction railway from Servia is being pushed on. As to the junction with Mitrovitza, our ambassador, Count Pallavicini, has been instructed to ask His Majesty the Sultan to grant authority for the construction of this line as it has already been surveyed. I trust sincerely that the Sultan will soon accord this authority, so that a syndicate of Austrian and Hungarian Banks may finance the projected line. [He refers to the now famous line projected through the sandjak of Novi Bazar which would give direct Railway communication between Vienna, Buda-Pest, and Salonica. The sandjak is shown in the ethnographic map at p. 60 of vol. xxii. of this *Magazine*.]

"It is only after these works are completed that it will be possible to consider the further establishment of this railway line, the difficult construction of which will demand several years. This line from Uvac to Mitrovitza ought certainly to be persevered in, because it not only connects the Bosnian railways with those of neighbouring countries, but also opens up an entirely new field for railways. Whenever the Bosnian railways are connected with the Ottoman lines, our traffic will be carried directly *via* Saraiévo towards the Aegean Sea and the Mediterranean. Further, it is to be hoped that a junction will shortly be effected between the Turkish and the Greek lines which will open direct communication between Vienna, Buda-Pest, Saraiévo, Athens, and the Piraeus, and will form the most direct route between Central Europe, Egypt, and India. On our part, we warmly support at Constantinople the Greek demands in view of this junction: it is in this way only that our politico-economical idea will be realised in its entirety. I hope that in these projects we shall be able to count the more on the Sultan's concurrence seeing that the linking of the Turkish railways with the Bosnian lines further north, and with the Greek lines further south, will open to the Macedonian vilayets a new economic era, and will thus contribute to make the populations of these countries take more interest in peaceful occupation.

"But it will be equally necessary to establish communications with Montenegro, and above all to construct a line between Cattaro and the

Montenegrine littoral; the question is actually under consideration; and when the plans are completed, we shall discuss them with the Principality on the basis of article 29 of the Treaty of Berlin.

"I consider that our Railway policy, of which I have given a rough outline, will greatly assist us in the effective transformation of the politico-economic conditions and in the maintenance of our position. At the same time, it will ensure new connections for our communications

Railways in operation.
Do. projected.

with the South, conditionally, of course, on our purely economic-political efforts being influentially seconded, not merely by the Balkan countries interested, but also by the wisdom and enterprise of our economic and industrial centres."

It is unnecessary to recall the sensation which this very progressive address of Baron von Aehrenthal's made in every quarter of Europe. There was not a newspaper either at home or abroad which did not describe it as a new departure of a kind which arrested public attention in no ordinary manner. It was like a stone thrown into a pool which

had remained so long stagnant that no one expected ever to see its waters move. But gradually suspicion and surprise gave way to calm contemplation, and to the admission that, after all, Baron von Aehrenthal's railway schemes might prove of great advantage to the Balkan peninsula. So much so, that other railway projects in that territory were introduced with as much enterprise as his own. Thus, while his railway lines ran mainly north and south, a great line running from east to west and linking the Roumanian lines on the Danube with a railway projected to pass through Servia, Turkey, and Montenegro to the Adriatic, was suddenly brought under the notice of Europe, and for boldness cast even Baron von Aehrenthal's schemes into the shade. This Danube-Adriatic railway project was at first supposed to owe its creation to Russia, but M. Costinescu, the Roumanian Minister of Finance, and one of the most experienced economists of Roumania, declared that not Russia, but Roumania, "has an economic interest in the opening of the Danube-Adriatic line."[1] At the same time, Russia, at the request of Servia, instructed its Ambassador at Constantinople to support the project for constructing a railway from the Danube to the Adriatic: and Germany and Italy also strongly supported the Railway schemes. Addressing the Reichstag on 24th March last, Prince von Bülow said, "We regard the increase of means of communication as a peculiarly suitable instrument for raising the state of civilisation to a higher level in these regions, and thus curbing the wild passions of religious and racial animosity"; adding, "Certainly, the atrocities which are perpetrated in Macedonia, by Christians on Mohamedans and by Mohamedans on Christians, are a blow in the face to the civilisation of Europe, and to the humanity of our age."

With regard to Baron von Aehrenthal's advocacy of the junction of the Turkish railway at Ghida to the west of Salonica with the Greek railway at Larissa—(Ghida is only 56 miles from the Greek frontier, to which a line is being actively pushed from Larissa), it was reported from Belgrade that Servia would gladly support the aspirations of Greece for the linking-up of the Piraeus-Larissa railway with the Turkish line, and considered that this would be of great commercial advantage to Servia.[2] The voyage from the Piraeus to Port Said is shorter than that from Brindisi by 373 miles.

In the well-known Parisian journal entitled *Questions Diplomatiques et Coloniales* of 1st March 1908, M. René Henry gave a masterly review of the whole question. By the kindness of the editor of that journal, we are privileged to reproduce the map which illustrated M. Henry's article. This map shows at a glance the railways made and proposed to be made throughout the Balkan peninsula, and which, when completed and extended, ought not merely to promote the prosperity of its inhabitants, but also to bring the peninsula into closer and happier relations with the commerce and civilisation of Europe.

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[1] *Scotsman* of 2nd March 1908.

[2] *Times* of 24th Feb. and 23rd and 25th March 1908. See also the author's paper on Athens in this *Magazine* for August 1907.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

At a Meeting of Council held on the 2nd April, the following gentlemen were elected members of the Society :—

Sir Charles Bruce, G.C.M.G. Frederick L. Grosvenor, F.S.Sc.
J. Foster Stackhouse, F.R.G.S.

Diploma of Fellowship.

The Council conferred the Ordinary Diploma of Fellowship on T. S. Muir, M.A., J. Foster Stackhouse, F.R.G.S., and Frederick L. Grosvenor, F.S.Sc., who have complied with the prescribed conditions.

GEOGRAPHICAL NOTES.

Europe.

The Delta of the Po.—The *Rivista Geografica Italiana* for December 1907 publishes the first part of an article on "Recent Changes in the Delta of the Po" ("Sulle recenti trasformazioni del delta del Po, 1893-1904"), by Mario Baratta. The writer refers to a communication in 1898 by the late Professor Marinelli on the increase of the Delta during the nineteenth century, and he has thought that a further study of the subject up to date is necessary, in view of the recent investigations concerning the advisability of opening up direct canal communication between the Po and the outside Adriatic. Baratta's plan was to make transparencies of the maps of 1893 and 1904, and to superimpose one on the other. The effect is to show that considerable changes have taken place. The changes are twofold; the one caused by the sediment carried down by the river, the other by the wasting action of the sea. The results show that a general advance of the line of the delta has taken place at a rate of 70 to 80 metres yearly, the additions being chiefly at the active outlets, the Bocca della Pila, in particular, giving 1600 metres in the eleven years, or an average of 136 metres in the year. It is shown in the composite chart that the northern part of the delta, where the smaller branches find their way to the sea, is gradually flattening out and diminishing, while the contours around the great mouths of the Po della Pila, and the Po delle Tolle to the south, have much increased. The importance of the figures now recorded is chiefly that they will serve as a useful basis for future observations, for while the author insists on the value of bathymetrical records in showing where silting will most readily take place, he points out that this branch of the investigation was entirely left out in the older surveys.

Italian Statistics.—We have received from the Department of Agriculture of Italy the first volume of the *Annuario Statistico Italiano* for 1905-7, the second part of which will appear later on. The present volume deals with the statistics of the geography of Italy, its climatology, population, hygiene, public instruction, and many other subjects of importance. It is pointed out in the introduction that this is not a mere compilation of figures from departmental sources, but a carefully reasoned commentary on the information which it summarises, providing through footnotes and headings of chapters the means of making the dry bones of figures more intelligible. Moreover, information has been gathered and tabulated which is not otherwise accessible. There is one very important feature:—Now for the first time, the various figures are contrasted, not only with those of immediately preceding years, but with more remote groups. The statistics of mortality, for instance, are put in contrast with the period of 1872-5. The value of such methods is obvious.

The tables and other information in the geographical section have been largely framed by Professor Giovanni Marinelli, which is a guarantee for their excellence.

Karst Phenomena.—Professor Émile Chaix-Du Bois has sent us a reprint of an illustrated article, which originally appeared in *Le Globe* (xlvi.), on the "Lapiés" in Carniola and the Steineres Meer. The special feature of the article is the series of photographs which accompanies it, many of them being stereoscopic views; these afford admirable illustrations of the phenomena of erosion in limestone regions, to which the name of Karst phenomena is conveniently applied. The special points which Prof. Chaix-Du Bois's memoir bring out are the following: First, he and his collaborator, M. André Chaix, emphasise the influence of snow. Where snow lies in hollows on the rock surface it acts like a sponge always saturated with carbonic acid, and tends to produce in the rock beneath a rounded, smooth, and deep *doline*. Deposits of soil have a similar action, retaining the carbonic acid, and thus tending to smooth off all angularities by the slow action of this superimposed layer of acid-retaining material. On the other hand, where there is no snow and no layer of soil to retain the carbonic acid, the rock erodes into hollows and crevasses with abrupt angles. The smoothing action of soil is greatly increased if much vegetation is developed on the surface of the soil deposit, for the plants greatly increase the supply of acids. The result is that in the well-wooded regions denudation is much more rapid than in the desert regions, and in such regions the rounded *doline* is the typical form. The existence of many such dolines in regions now devoid of vegetation is to be explained by the former presence of extensive forests over these regions.

The Land Vegetation of the Faeröes.—We have received from Mr. C. H. Ostenfeld a pamphlet with this title, being a reprint of part of his monograph on the Botany of the Faeröes. The pamphlet, which is in English, has been somewhat modified as compared with the Danish

edition, Dr. W. G. Smith having assisted in the task of finding English equivalents for the Danish ecological terms. The whole forms a most interesting contribution to ecological botany, the illustrations especially being very striking and chosen with great care. We have already given here recently (xxii. pp. 61 and 134), in a paper by Mr. James Currie, a comprehensive account of these islands, and can only call attention now to a few of the more geographical points in connection with Mr. Ostenfeld's paper. It includes some interesting details in regard to the climate, studied in connection with the natural covering of vegetation. Of the climate we may say in brief that it shows in exaggerated form the peculiarities of that of the northern part of Britain. Despite the latitude a continuous snow-covering in winter is infrequent, and never of long duration; snow thus plays quite an insignificant part in protecting the vegetation from cold. On the other hand, the climate being markedly insular, the cold is never severe. There is abundance of precipitation, uniformly distributed throughout the year, and therefore xerophytes are rare among the plants of the Faeröes. Even more interesting perhaps is the rarity of annuals. The summers are cool, the winters not cold; vegetative growth is thus nearly continuous, but is slow throughout the year. This is of course in marked contrast with the conditions required for annuals, which must have a sudden, hot summer in order to flower and fruit before the cold of autumn begins. Again, the climate is predominantly windy. This renders existence impossible for trees and the larger shrubs, except where artificial shelter is given, and produces throughout a tendency to dwarfing. This last tendency is accentuated by the action of the sheep. The influence of wind is not, however, only shown in the absence of tall plants, but also in the shortening of the flower-stems of those growing in the more exposed valleys. The absence of bees and butterflies, and the predominance therefore of self- and wind-fertilised flowers probably makes this shortening of the flower-stalks less injurious to the well-being of the species than it would otherwise be. Even, however, the close-growing plants of the wind-swept situations cannot always protect the soil from denudation by wind, and some striking photos are given of regions swept bare by the wind, a very curious example of desert conditions produced where the usual agents—great changes of temperature, alternation of torrential rain and drought—are both absent. One of the photos of a region largely denuded by wind shows a striking resemblance to the "Badlands" in the western United States (cf. xxii. p. 10), where the destruction of the covering of vegetation is due to quite other climatic conditions.

We cannot here give any details as to the plant formations classified by the author, but may just note in passing the great value of studies of this type to teachers, in that they definitely correlate the plant covering to the various other conditions—climatic, geological, economic, and so forth—obtaining in the area under consideration, and it is in such study of correlation, in our opinion, that the essence of geography lies.

Asia.

Dr. Stein's Expedition.—Recent letters have brought our knowledge of Dr. Stein's work in Central Asia down to December 10 last. These letters are dated from Kara-Shahr, and give an account of the work done between June 18 (cf. this *Magazine*, xxiii. p. 598) and that date. The period included weather too hot to make research in the desert possible, and on leaving An-shi at the end of June, Dr. Stein devoted himself to geographical work in the western and central Nan-shan.

Dr. Stein's first move from An-shi led towards the great snowy range south, which forms the watershed between the Su-le-ho and Tun-huang rivers. On the lowest of a succession of barren plateaus, built up by parallel outer ranges, he discovered a large ruined site at some distance from the village of Chiao-tzu. The ruins of the town, abandoned about the 12th-13th century A.D., afford interesting proofs of the processes of desiccation and wind-erosion which have since materially altered the physical and economic conditions of the outer hill region.

After surveying the great chain of glacier-crowned peaks which overlooks the barren outer ranges and detritus plateaus of the Nan-shan west of the Su-le-ho, Dr. Stein and his companions made their way over hitherto unexplored ground to the foot of the mountains near the famous Chia-yü-Kuan gate of the "Great Wall." Here a short stay enabled him to clear up an archæological problem of considerable historical interest in connection with the "Great Wall." The imposing line of this wall, which bends round the westernmost part of the Su-chou oasis and extends to the very foot of the Nan-shan, has always been represented in books and maps as the end of the ancient "Great Wall" guarding the northern border of Kansu. Yet with this assumption it was difficult to reconcile certain early Chinese notices which seemed to place that famous gate much further to the west, and still more forcibly there spoke against it the remains of that ancient *limes* which Dr. Stein's explorations in the spring had revealed as extending from An-shi westwards into the desert of Tun-huang. Careful examination on the spot disclosed near Chia-yü-Kuan the junction of two lines of frontier defence of widely different age and purpose. One line, represented by the crumbling wall of stamped clay which runs along the whole northern border of the Su-chou and Kan-chou districts, was proved by certain ruins to have originally continued westwards in the direction of An-shi and the Tun-huang lines, and to date, like the latter, from the second century B.C. Its manifest purpose was to safeguard the narrow belt of oases along the north foot on the Nan-shan, which was indispensably needed as a passage into Eastern Turkestan when Chinese political and commercial expansion towards the "Western regions" had commenced under the first Han dynasty. The second line, which meets this ancient wall at right angles and through which the Chia-yü-Kuan Gate leads, was shown to be of far less ancient construction, and probably does not go back further than the 15th-16th century A.D. It was built for the very different purpose of closing the great route towards Central Asia

and the West, at a period when China had once more resumed her traditional attitude of seclusion.

Su-chou, the first town "within the Wall," served as base for Dr. Stein's expedition into the Central Nan-shan. Guides were obtainable only as far as the broad plateau-like valley between the Ihekhodon and the Tokai-shan range, where some gold pits situated at an elevation of about 13,000 feet are worked for a few months annually. After leaving these exposed mining camps, where the snow had barely melted by the beginning of August, no human beings were met with, until the travellers towards the close of the month came upon Mongols grazing in the valleys south of Kan-chou.

Dr. Stein and his party managed during August to cross and survey in detail the three northernmost ranges of the Central Nan-shan, all rising to peaks of 18,000 to 19,000 feet, between the longitudes of Su-chou and Kan-chou. All the rivers descending to these bases as well as the Su-le-ho, which flows towards An-shi and Tun-huang, were explored to their glacier-fed sources. The magnificent ice-crowned range which divides the headwaters of the Su-le-ho from the Koko-nor and Khara-nor drainage was also surveyed along the whole length of its north face. Here in individual peaks and average crest line its height proved to exceed that of the northern ranges. It was curious to meet in the wide mountain-girt basin, over 13,000 feet above the sea, where the Su-le-ho gathers its main sources, the same combination of marshes and drift sand areas which is the characteristic feature of the desert depression where the river dies away between Tun-huang and Lop-nor. From there Dr. Stein and his party made their way over difficult bog-covered uplands into the unexplored alpine tract where the Ta-tung river—the northernmost large tributary of the Yellow River—rises and after this short visit to the edge of the Pacific drainage regained the broad valley of the upper Huei-ho, or Kan-chou river.

The total mountain area covered by Rai Ram Singh's plane-table survey, on the scale of four miles to the inch, between An-shi and Kan-chou, amounts to close on 24,000 square miles. The position of numerous stations was fixed astronomically by theodolite observations, and reliable height measurements secured for all important peaks and passes by means of mercurial barometer and clinometer readings. As a supplement to the topographical work a large series of photographic panoramas was taken by Dr. Stein, illustrating the characteristic features of the great ranges as they presented themselves from commanding positions.

From Kan-chou Dr. Stein began early in September the long journey back to the Tarim Basin. The journey was made by the caravan route via Hami and Turfan, and much survey work was done en route. At the date of writing he was on the eve of beginning his winter's work of archæological exploration.

AFRICA.

The Congo-Kamerun Boundary Commission.—An article in the

Revue Générale des Sciences for February 29 gives a fuller account of the results of this Commission than has hitherto been available. The Commission was under the charge of Commandant Moll, and in concert with a German Commission had for its object the delimitation of the frontier between the French Congo and the Kamerun from Bomassa, to the north of lat. 2°, to Lake Chad. In their progress from the south to the north the party distinguished three zones of country. The first, that of M'Biemou, extending from the 2° to 4° N. lat., is essentially a forest zone, being a part of the equatorial forest. The vegetation is so thick that progress is difficult, and in the clearings only very small villages occur, inhabited by primitive and cannibal peoples. Elephants are numerous in the forest, and the chief other source of possible revenue appears to lie in the rubber, which is abundant.

The next region, that of the Upper Sanga, stretching from 4° to 6°, is watered by many streams, and rises in elevation as one approaches the north. By successive steps heights of 1000 to 1200 metres are reached, and towards the 7th parallel even of 1400 to 1500 metres. The climate and soil lend themselves to various crops—rubber, cotton, tea, tobacco, coffee, oil-palms, etc. The population belongs to the Baya race.

The third zone, lying between 6° and 7° N. lat., is limited to the north by the valley of the Mambere, and forms an important water-parting. From it the waters run in three directions—towards the Kamerun, towards the Congo, and towards Lake Chad. The country is rocky and picturesque, with many granitic masses, from which cascades fall. The population is scanty, and the country of no great commercial value. It is, however, of importance in connection with the problem of the best routes from the Mid Congo to Lake Chad. This region, the Upper Baya country, is limited to the north by the deep valley of the Mambere. On leaving this mountainous region the Mambere joins the Logone. The Commission followed this stream, partly by stream and partly by land, up to Lai. The river varies in breadth from 80 to 300 metres and is only interrupted by the rapids of Kaitia. Near Bakassi, above Lai, the western Logone joins the Bandul, or eastern Logone, which comes from the Pennde. The chief affluents of the Logone were studied, and also the depression of Tuburi. The region here has fine pasture ground, which would support more cattle than are actually to be found at present. The soil also is suitable both for the native crops and for cotton. The marshy ground lying between the Logone and the Shari (cf. Captain Lenfant's map, xx. p. 306) was also studied. This region is of little or no economic value and is difficult to traverse. Owing to the absence of wood on its banks the Logone is difficult to navigate, while the conditions on the Shari are more favourable.

In addition to the geographical observations pure and simple, the domestic animals of the districts traversed were studied. Horses and cattle appear in lat. 8° 30', and beyond 9° both become abundant, the country being pastoral in type. The regions rich in rubber have also been carefully noted, no less than those likely to be suitable for cotton. Ethnographical and other investigations were also made by the Commission.

The Domestication of the African Elephant.—An extra publication of the *Bulletin Officiel de l'Etat Indépendant du Congo*, 10-12, 1907, gives an interesting and detailed account of the efforts being made in the Congo Free State to domesticate the African elephant, and shows that more success has crowned these efforts than has hitherto been believed. The pamphlet deals with the experimental station established at Api, in the Welle district. Between the posts of Amadis and Angu the territory to the north of that river consists of well-watered plains, with trees along the water-courses, while that to the south is thickly wooded, the region being indeed the limit of the equatorial forest. In the marshy regions of this forest elephants are very abundant, and the pamphlet gives a very interesting account of the habits of the wild form, which spends the day in the forest, but wanders over the plains at night. The attempt to tame adult forms proved wholly unsuccessful, and the efforts of the staff of the experimental station have therefore been limited to young forms. These are to be found at all seasons, but the difficulties in the way of capture are great and the mortality among those captured enormous. It is this indeed which is the great obstacle in the way of domestication, for if the animals can be kept over the first year the difficulties are greatly diminished. Frequently the animals die within a few hours, sometimes even a few minutes, of their capture, and in these cases post-mortem examinations have failed to show any marked lesion. It would almost appear as if the animals succumbed to the shock of finding themselves in captivity. Again, new arrivals are frequently attacked by the elephants already within the stockade, and even small wounds show a great reluctance to heal, and are often followed by blood poisoning. Further, the animals are exceedingly sensitive to the sun, and seem often to die of sunstroke at very slight exposure—in their natural habitat they are apparently very completely protected by the dense forest during the daytime. This risk can, however, be avoided by never allowing the elephants to be exposed during the hottest hours of the day. At the present time the herd at Api consists of twenty-five animals, of which some have lived in captivity for five years. These animals allow themselves to be mounted, both by their native mahouts and by Europeans. The oldest animal is not more than seven years old, and the Indian elephant does not work with any effectiveness until fifteen, when the elephant is adult. The Api specimens, however, already do regular work, though it has been found that they soon succumb to any excess of work. Some of them carry bricks for building, others have been trained to draw the plough, others are harnessed to small carts to convey various materials. The special merit of the animals is their extraordinary skill in finding their way through marshy ground where no other domestic animal is of any avail. In such places, thanks to their broad feet, they do not sink, and they carefully remove obstacles from their path by means of the trunk. They can climb slopes of some steepness, going down on their knees for this purpose, and helping themselves up with their tusks and trunk. Going down a slope, on the other hand, they bend the posterior limbs and, stretching the front ones, slide down to the bottom. The point of

importance, then, is that the elephant seems practically the only animal which can safely traverse a country of forests and savannas interspersed with marshes. Now, much of the Congo region consists of precisely such country, and despite railways, navigable streams, and automobile routes, there must always be a great part of the country where the elephant only can replace the costly and slow human porterage which at present is the only means available. An admirable swimmer, immune to fly disease, fearless of swamps, the elephant seems destined to fulfil a great rôle in the development of the country if the domestication experiments can be continued satisfactorily. It is probable that, as in India, breeding in captivity will be found impossible, but the wild form is so abundant in the forests that with proper regulation the supply should be inexhaustible. The details given in the pamphlet show that no pains are being spared to make the experiment a success, and it will be a remarkable feat if at this late date in civilisation the Belgians succeed in adding another member to the group of man's four-footed servitors.

Polar.

Arctic Research.—Among the notices of prospective expeditions which have recently appeared in the public press, it is interesting to observe that the Swedish government proposes to send a party this summer to Spitsbergen for geographical and geological research, under the leadership of Professor Gerard de Geer, Rector of the University of Stockholm. In another part of the Arctic area we note that the Russian Ministry of Marine is preparing an expedition with the object of discovering a north-east passage between the Atlantic and Pacific Oceans, and thus facilitating naval communication between Western and Far Eastern Russia.

General.

The Royal Geographical Society's Awards.—The two royal medals of this Society for the current year have been awarded—the Founder's Medal to Lieutenant Boyd Alexander for his journey across Africa, and the Patron's Medal to H.S.H. The Prince of Monaco for his oceanographical work. Lieutenant-Colonel Delmé-Radcliffe receives the Murchison grant for his survey work as Resident in the Nile Province of the Uganda Protectorate, and as chief of the British section of the Anglo-German Commission for the survey of the frontier between the Victoria Nyanza and Ruwenzori; Dr. T. G. Longstaff the Gill Memorial for his explorations in the Himalayas; Rai Sahib Ram Singh the Cuthbert Peek Grant for his survey work in Tibet and Chinese Turkestan; and Lieut. Geo. Mulock, R.N., the Back Bequest for survey work and mapping in connection with the National Antarctic Expedition.

Fund for Scientific Research.—Prince Roland Bonaparte has announced his intention of placing at the disposal of the Paris Academy of Sciences a sum of 100,000 francs (£3960) for the encouragement of

scientific research. It is not the desire of the Prince that the sum be used as capital, but rather that it should be expended freely to enable workers of proved competence to carry out pieces of scientific work which they would otherwise be unable to undertake from lack of funds. The Prince also expresses a hope that his contribution may serve as a nucleus of a permanent fund for the object indicated.

Meteorological Conference.—A conference of meteorologists representative of the United Kingdom and of the British Colonies and dependencies is to be held in Quebec in the last week of July, on the invitation of the Royal Society of Canada. The date has been determined by the fact that the conference is to immediately follow the celebration of the tercentenary of Champlain's landing, and will almost coincide with the Geographical Congress at Geneva.

Determination of Longitude at Sea.—The Paris Academy of Sciences has appointed a Committee, composed of MM. Becquerel, Bouquet de la Gyre, and Poincaré, to consider a suggestion by M. Bouquet de la Gyre concerning the application of wireless telegraphy to the problem of the determination of longitude at sea. The idea is to utilise the wireless telegraphy station of the Eifel Tower to send, for instance, a Herzian signal every night at midnight giving the time of the meridian of Paris. M. Bouquet is of opinion that if a station were established on the peak of Teneriffe signals could be detected completely round the earth.

Commercial Geography.

The Resources of Ceylon.—Sir Henry Blake, late Governor of Ceylon, delivered recently in London a lecture on that island before the Royal Colonial Institute, from which we extract the following details. After speaking of the export of gems, of which the total annual value sold amounts to £200,000, the lecturer went on to speak of the cocoanut which supplies in various products over 21 per cent. of the exports of Ceylon. The acreage under cocoanuts is 987,030, and the capital embarked in the industry over £37,000,000 sterling. The acreage under tea in 1906 was 461,260, and the total weight of the tea exported was 170,527,126 lbs. The average return was 370 lbs. per acre, on which at present a duty amounting to £3, 1s. 8d. per acre is paid on the tea imported into the United Kingdom. Tea supplies in value 56·7 per cent., and cocoanuts 21·2 per cent. of the total exports. But within the past four years another industry has come to the front that widens the basis of Ceylon prosperity, and bids fair to become the second in value, if not the leading export of the island. This is rubber. Up to the middle of last year the area acquired and being cleared for rubber was over 120,000 acres, and companies have been formed with an aggregate capital of £700,000. Sir Henry Blake calculates roughly that the cost per acre of rubber in seven years, including purchase, clearing, planting, weeding, and interest on outlay, would average about £22. There are at present at least 140,000 acres planted with rubber in Ceylon, which, he estimates, would in six years return annually 14,062

tons, value £3,937,360, which would almost equal the value of tea exported in 1906. The products that come next in importance are plumbago, cacao, and cinnamon. The value of plumbago exported in 1906 was £697,000, and over 19,000 people are employed in the industry. Camphor is being planted, but not to a great extent. It is a highly remunerative crop, the return at present prices being more profitable than even that from rubber in full bearing.

EDUCATIONAL.

We have received an intimation to the effect that Prof. W. M. Davis of Harvard University proposes to spend June and the greater part of July in northern Italy and the Alps, studying certain geographical problems. He would be pleased to have associated with him a number of advanced students, already somewhat practised in field study. The circular sent to us gives some details of the proposed itinerary, which includes a study of the NE. foothills of the Apennines near Ancona; of the non-glaciated valleys of the NE. Apennines in the neighbourhood of Faenza; of the basin of Florence; of the Mediterranean coast between Pisa and Spezia, Spezia and Genoa, and west of Genoa; of the divide between the headwaters of the Po, north of Genoa, and the Mediterranean streams; of the relation of the border of the Po plain to the foothills of the Alps, and of changes in river-courses in the headwaters of the Po; of glacial phenomena and glacial lake basins in the Alps (Como, Luggano, Maggiore); of the valleys of the Dora Baltea and Dora Riparia; of glaciated valleys in the French Alps; of non-glaciated valleys in the Cevennes.

It is not intended that the members of the party should travel continuously together; the party may be joined and left at any time as agreed upon. The persons participating must satisfy Professor Davis as to their qualifications, and are requested to communicate with him as soon as possible to one or other of the following addresses:—Until May 10, c/o Messrs. W. J. Turner and Co., Naples; until May 20, c/o MM. Sebasti e Reali, Rome; until June 30, c/o Messrs. Kuster and Co., Turin.

Each member of the party will be required to make his own travelling arrangements and pay his own travelling expenses, and the expedition will conclude with a meeting at Grenoble, about July 18, when results will be discussed. Professor Davis's circular, which contains some information in regard to objects and methods in addition to that summarised above, can be consulted in the Society's Rooms. It will be noted that the proposed excursion precedes the Geographical Congress at Geneva, and thus affords an admirable opportunity for geographical work to those persons who propose to attend the Congress and are at liberty in the months indicated. It is anticipated that more than one nationality will be represented in the party, and some interesting results may be expected.

Teachers will find some interesting facts in connection with methods of transport in different parts of the globe in an article by the Hon. O. P. Austin, Chief of the U.S. Bureau of Statistics, in the *National Geographic Magazine* for November 1907. The subject is one on which it is not always easy to obtain detailed statistics, and yet it is one that should be treated even in elementary classes, if the pupils are to have any real grip of the basal facts of economic geography. The author gives one hundred millions as the total number of horses in the world, of which eighty millions, or four-fifths of the whole, occur in the temperate zone, chiefly in the west, while the remaining twenty millions found in the tropics are there largely used in the service of visitors or residents from the temperate zone. In Canada and the United States there is stated to be 1 horse for every 3½ persons, as against 1 for every 200 in India and Southern China. The absence of the horse in the tropics is assigned to climatic conditions, and its rarity in the Orient to the dense population which makes it impossible to put aside land for the maintenance of the animal. After discussing the other draught animals available, and the use of human labour as a means of transport, the author emphasises the enormous part played in the development of temperate regions by the horse, and discusses the possibility of replacing it by mechanical means of propulsion in those regions where it cannot be utilised on the large scale. The use of railroads is obviously limited by questions of cost, but there seems a great future for motor-propelled vehicles. At the present time motor cars are being extensively used in the desert regions of New Mexico and Arizona where the heat is so great that horses and mules cannot be used in the day time. In Nevada a single motor truck is now doing the work of thirty horses, in carrying freight over two hundred miles of mountain roads. Similarly in the West Indies, in parts of South America, the motor car is replacing the horse and the donkey; in Egypt it is beginning to replace the camel, while in other parts of Africa, in India, and elsewhere experiments are in a more or less advanced stage. There thus seems hope that the motor-propelled vehicle will do for tropical and eastern regions what the horse has already done for the temperate and western parts of the globe.

NEW BOOKS.

EUROPE.

Highways and Byways in Hampshire. By D. H. Moubray Read. London: Macmillan and Co., 1908. *Price 6s.*

Hampshire has historical associations which will always make it famous. Alfred the Great made Winchester his capital, and was at first buried in the Cathedral, whose builders strangely founded it on "a bed of soft marl, only 10 feet below the surface, permanently washed by water which, in wet seasons, rises some feet above it." No wonder the Cathedral is in jeopardy, but Mr. Read is gratified to think that the danger was not discovered a century ago, or the "grand fane would have been replaced by some Georgian monstrosity."

A Scottish princess, daughter of Malcolm Canmore, lived in the beautiful

Abbey of Romsey and was wooed by William Rufus, but unsuccessfully. She represented the old Saxon line once dominant here.

Mr. Read does not admire the latest arrival in Hampshire, the great watering-place of Bournemouth, which he seems to have unluckily visited in November, when most places look at their worst. Yet Louis Stevenson lived there, and in 1886 dedicated his *Kidnapped* from "Skerryvore" in the Alum Chine Road. Mr. Read does not mention this, but Stevenson should have a niche in the Hampshire Valhalla.

The book is well written and illustrated, but the map ought to have been a more modern and orographic one.

The Soul of Spain. By HAVELOCK ELLIS. London: Archibald Constable and Co., 1908. *Price 7s. 6d. net.*

Leon, Burgos, and Salamanca: A Historical and Descriptive Account. By ALBERT E. CALVERT. With 462 illustrations. London: John Lane, 1908. *Price 3s. 6d. net.*

Spain having been established as one of the most fascinating provinces for the British tourist to explore, books like the above are warmly to be welcomed. Both illustrate aspects of Spain and its people of peculiar interest and value, and both are by very reliable and erudite authorities. While, in Mr. Ellis's work, we have a masterly analysis of the leading features of social, artistic, and literary Spain, in Mr. Calvert's we find a splendidly illustrated account of three of Spain's leading cities with their wealth of architectural details.

Mr. Ellis gives Italy precedence over Spain for the student of European civilisation, but these two volumes alone will make some doubt whether, in some respects, this is just. No painter ever excelled Velazquez, whose glorious works can best be seen in Madrid. The church architecture of Spain is probably superior to that of Italy. Though Italy is supreme as regards the vestiges of ancient Rome, those left by the Moors give to many Spanish cities an embellishment as graceful as it is historically interesting. Besides, Spain has not been for generations, like Italy, the well-trodden field of tourists, and the country and its people remain to a large extent unaltered. In some Spanish cities we may still see the houses occupied by Cervantes, a contemporary of Shakespeare. At the same time, the hotels in the leading cities of Spain are now good enough even for the fastidious, and railway communication has been improved so that even *trains de luxe* traverse the plains associated with the name of Don Quixote. Add to this the splendid climate enjoyed by many parts of Spain, and a quiet, dignified, and polite population, and we venture to say that no part of Europe will prove more attractive or instructive to the historical or artistic student or even to the ordinary traveller.

ASIA.

The History of Babylonia and Assyria. By HUGO WINCKLER, Ph.D., Professor in the University of Berlin. Translated and edited by JAMES ALEXANDER CRAIG, Ph.D., Professor of Semitic Languages and Literature in the University of Michigan. London: Hodder and Stoughton, 1907. *Price 6s.*

A perusal of this exceedingly interesting monograph provides for the reader material on which to think *furiously*. He cannot fail to be impressed with a sense of the immensity and difficulty of the complex task, which is now in the

hands of a comparatively small group of Assyriologists, Egyptologists, and antiquarians working in Europe and in America. What they have undertaken is nothing less than to construct the history of several ancient empires, viz. Egypt, Assyria, Babylonia, Media, Chaldæa, etc., history, also, such as we now require of our historians; not a mere record of dynasties, wars, and political movements, but, in addition to these, an accurate and scientific exposition of the development and progress of races and nations with their social conditions, laws, religions, customs, manners, literature, arts, sciences, etc. The period treated in this book is roughly four thousand years, and the materials at the service of the historian, although merely fragmentary, are even now far greater in amount than the experts who are deciphering them can manage, and yet they are but a fraction of what, we believe, will in course of time be secured by the numerous parties now busily engaged in excavating the sites of ancient cities and mounds in Mesopotamia and the valley of the Nile. Already it has been made abundantly clear that our knowledge of Assyria, Babylonia, and Egypt, derived from such authorities as Herodotus and Xenophon, Isaiah and Ezekiel, must be thoroughly revised and modified in the light of discoveries which are daily coming to hand. The truth about not one, but several civilisations long since extinguished, is being slowly but surely disclosed, and must have a real fascination for almost every class of student. In Professor Winckler they have a learned, judicious, impartial, and experienced guide, whose lucid, thoughtful, and concise monograph will serve as an excellent introduction to severer and more detailed study.

To Jerusalem through the Lands of Islam among Jews, Christians, and Moslems. By Madame Hyacinthe Loyson. Open Court Publishing Co., Chicago, 1905.

In 1894 the authoress and her husband, the well-known Père Hyacinthe, left Paris for a tour in the East which lasted two years, and this is the record of it. Although American born, Mme. Loyson, from long residence in France, has acquired an ecstatic French style, reminding us of Pierre Loti's *India*. After a visit to Algeria the travellers sailed to Malta, and were horrified at the number of its drinking-shops. They went on a pious pilgrimage to the bay where St. Paul was wrecked, and found, as they approached what they deemed a sacred spot, a wayside inn on which they read, printed in enormous letters, these words: "This is the last chance to get your grog." As for the Maltese, they stared at "the married monk and his wife," yet one of them, who she remarks was "a very pious Roman Catholic," said very solemnly: "Who knows if St. Paul himself was not married when he came to these shores?"

In Egypt Mme. Loyson was distinctly sympathetic with the Nationalist faction, yet she admits that the British have "re-created Egypt financially." Regarding Christian missions, she reproaches "those missionaries who, actuated by a narrow spirit of sectarian proselytism, or being victims of ignorance, repudiate or ignore the value of other great religions of such incontestably superior order as those of Islam, India, and China, of which they should certainly have made careful study."

In Palestine they lived at Jaffa with the Coptic Archbishop of Jerusalem in "the finest ecclesiastical residence in Palestine." She says the archbishop has "a large estate at Jaffa," and that the Abyssinians in Palestine are protected by the Copts. Reaching Jerusalem, they found "the Jewish slums outdo all for filth." The saddest sight, however, they saw was at Bethlehem, where two young Christian girls offered them for sale small plaster cakes, which the girls said were "little cheeses made from the milk of the Holy Virgin"! Our travellers were

stoned in Hebron by little Moslem children. They bathed in the Dead Sea and found its water less buoyant than they expected. The volume is an interesting one, although written occasionally in rather a high-flown strain.

AFRICA.

Cape Colony To-Day. By A. R. E. Burton, F.R.G.S. Published under authority of the Cape Government Railway Department. Cape Town, 1907.

Mr. Burton writes with a pleasant air of enthusiasm, and his copious information touches every place of the least importance. But he also surveys the different industries and interests of the Colony, and has special articles on such subjects as the native tribes, the flora, and the railways. The illustrations, of which there are many, and the maps, are both good. Tourists and settlers may alike consult the volume with advantage.

The Passing of Morocco. By Frederick Moore. London: Smith, Elder and Co., 1908. *Price 5s. net.*

Writers of the journalistic school have an audacious habit of anticipating the future in the titles of their works. Thus we have had books on the Sultan's Doom and the Czar's Downfall, and now Mr. Moore gives us *The Passing of Morocco*, the fact being that Morocco is still very much alive and is likely to give Europe trouble for many years to come. The French have penetrated as yet only 50 miles from the coast, and there must be other 350 miles to the confines of Algeria.

As his *Balkan Trail* showed, Mr. Moore is a capital writer and an indefatigable explorer. He went to the front near Casablanca with a Scotsman who photographed the fighting for a newspaper. Owing to the superior weapons of the French, Mr. Moore calculated, that on an average, fifty Moors were killed to one French soldier wounded. He found drunkenness and disorder exceedingly rare in the French ranks, and remarked the extraordinary marching power of the infantry, a man in which will carry two days' rations and a portion of a "dog tent" and cover nearly 50 miles in a day and a night.

Mr. Moore gives a picturesque account of Tangier, and instances among the reforms introduced there by the foreign Powers, during the last thirty years, that a man may no longer be flogged in public, or a slave sold at auction, or the heads of the Sultan's enemies exposed upon the gates. He visited Laraiche and noted its poverty and degradation, although its Kasbah (or Citadel) is a particularly fine example of Moorish architecture. He also visited Rabat and crossed the river to Salli, once the headquarters of the dreaded Moorish pirates called "Salli rovers," the capturers of Robinson Crusoe. With difficulty, as the city is sacred, the author was allowed to enter Salli and found in its centre a cone-shaped hill crowded with houses of the best class and crowned by a mosque. The people of Salli are the wealthiest in Morocco. Twenty ladies of the Harem of Sultan Abdul Aziz arrived at Salli when Mr. Moore was there, and he gives a photograph of them seated on mules. He also saw the Sultan at his function called the Selamlik, the Moorish band playing the British "God Save the King."

Mr. Moore found the British in Morocco violently opposed to the Anglo-French Agreement of 1904, but he, an American, is in favour of France "having a free hand in Morocco," in terms of agreement. He declares that Morocco is suffering from crime, corruption, needless cruelty, and bestial vice, and concludes: "The French can do some little for Morocco, and no other Power can go in. I say, Let in the French!" The book contains nice illustrations and a good map of Morocco.

AMERICA.

Archhelenis und Archinotis: Gesammelte Beiträge zur Geschichte der Neotropischen Region. By Hermann von Ihering. Pp. 350. 1 Map and 1 Fig. Leipzig: W. Engelmann, 1907. *Price* 6 *Marks.*

At intervals during the last twenty years Von Ihering has advanced arguments in support of the thesis that South America has undergone very radical geographical changes since the Cretaceous period. He has endeavoured to show that these important changes can be inferred from the facts of the geographical distribution of plants and animals. His general position is that the Brazil of the early Tertiary age—Archi-Brazil as he calls it—was united to Africa by a land-bridge which broke down in the Oligocene. This lost bridge was Archhelenis. But furthermore, Von Ihering holds that Patagonia, Tierra del Fuego, the Falkland Islands, and Chili as well, which together make up Archi-Plata, were united to a great Antarctic continent, to wit Archinotis.

In the present volume Von Ihering has brought together his scattered papers (from 1878 to 1907) bearing on the past history of the South American Continent, and the cumulative argument is very interesting. Whether the conclusions be right or wrong, the essays are fine illustrations of a method of inquiry, and the illustrious author is nothing if not ingenious, as the essay on "Helminths as aids in zoo-geographical investigation" may serve to show. Besides the contributions to the history of the neotropical region, there are some more or less relevant discussions of perhaps wider interest. Thus the third chapter bears the title "Private Property in the Animal Kingdom," and it is lively reading. To avoid misunderstanding, however, we must quote the sentence: "Privateigentum kennt man im Tierstaate nicht."

AUSTRALASIA.

New Zealand Revisited. By the Right Hon. Sir John Eldon Gorst. London: Sir Isaac Pitman and Sons, Limited, 1908. *Price* 12*s.* 6*d. net.*

The Maori war in New Zealand, which is now ancient history, as it began in 1863, is one on which we cannot reflect with much satisfaction. In 1860 Sir John Eldon Gorst made his debût in the public service as Civil Commissioner in the Waikato district of New Zealand, and in the volume now before us he describes to us in graphic and interesting fashion the ferment and unrest which preceded the outbreak of hostilities. He is frankly an enthusiastic friend and admirer of the Maoris, and holds that forty years ago they received but scant justice, although he is well aware that, sooner or later, it was inevitable that Great Britain must become the sole paramount and effective power in the colony. The subjugation of the brave Maoris was only a matter of time and opportunity, and in the end, *i.e.* at the present day, the results of the war, both to conquerors and conquered, are profitable in a degree and to an extent that at one time seemed hardly conceivable. Forty-three years afterwards, *i.e.* in 1906, Sir John again visited New Zealand, this time as the representative of the British Government at the Christchurch Exhibition, and received, as he deserved, a most cordial welcome from those who remembered him in the early sixties. He took the opportunity to revisit some of the scenes of his former duties, and he saw some of his old opponents, and the contrast between the New Zealand of 1863 and that of 1906 is the subject-matter of this book. The change effected in the economic, political, and social conditions of New Zealand in these forty years is hardly less remarkable than the change in the conditions of travelling to New Zealand, so

graphically described in the first chapter of the book. The problem of the future of the Maori race cannot even yet be said to be solved. Sir John Eldon Gorst thinks it depends more on physical than on political causes. The book, which, we may observe, is illustrated by some very good photographs, is well worth reading, as embodying the reminiscences of an able and judicious eye-witness of a very critical stage in the fortunes of one of our most interesting colonies, and the mature reflections thereon of the same eye-witness, developed into an experienced and trustworthy statesman.

GENERAL.

My Life in the Open. By WILL H. OGILVIE. London: T. Fisher Unwin, 1908. *Price 5s. net.*

From an introductory note by a somewhat injudicious but enthusiastic admirer of the author, we learn that Mr. Ogilvie was a Fettes boy who went to Australia and spent eleven years at a sheep station. Then he tried journalism for three years, after which he went to Iowa for a couple of years, and then he returned to Scotland to resume his profession of journalist. His previous works are said to be popular in the colonies, but are comparatively unknown in his own country. The *motif* of this work might perhaps be said to be the praise of agriculture, and of agriculture the author has had a pretty extensive experience, for he has studied it, and apparently practised it, in Australia, America, Africa, and Scotland. He is evidently very fond of animals, from horses down to sheep. He is an enthusiast for "life in the open" as compared with life in a city, and his book contains a series of breezily written and often amusing sketches of out-of-door life all over the world. It adds nothing to our stock of knowledge, but is pleasant and easy reading.

Die Entwicklung der Kontinente und ihrer Lebewelt. Ein Beitrag zur vergleichenden Erdgeschichte. By Dr. THEODOR ARLDT. Pp. xvii+729. 23 Maps and 17 Figs. Leipzig: Engelmann, 1907. *Price 20 M.*

Dr. Theodor Arldt has set his hand to the difficult task of tracing the successive stages in the evolution of continents, and of correlating with this the distribution of plants and animals in different ages. It is an ambitious study in palæogeography, which must have required great patience as well as much learning. The book says much for the resoluteness of the author in keeping the main issues clear amid all the detailed erudition, and it is remarkably orderly and effective in its arrangement of material. In great part Dr. Arldt uses the data of well-known geologists and palæontologists; his own particular contribution is that he tries to combine the two sets of facts in a unified historical picture. This has been tried before, and it will be tried again; that the picture will eventually become clear one can hardly doubt. A laborious piece of work like the book before us is a valuable contribution towards that result.

Various considerations, which have been often discussed, lead to the conclusion that the arrangement of continents and oceans cannot have been the same in the past as it is now. There has been an evolution—a development at least—and the author begins by discussing the "palæogeographical methods" which are available in this sort of historical study. Petrography, palæontology, botany, and zoology are made contributory to this archæological purpose.

Three hundred and fifty pages are devoted to a systematic survey of biogeography. That is to say, an account is given of the distribution of kainozoic,

mesozoic, and palæozoic organisms in relation as far as possible to the various regions—Australian, Neotropical, Malagasy (these three make the Palæogæic Realm), Ethiopian and Oriental (these two make the Mesogæic Realm), and Holarctic or Kainogæic. At the close of this survey there is an interesting interlude devoted to a discussion of the various habitats—marine, freshwater, terrestrial, etc., and the inevitable question of the origin of life receives due attention.

The second main section of the systematic part of the book is geological, and a hundred pages are devoted to former continents and oceans. Here we are told the fascinating story of North Atlantis, the Angdara Continent, the Mediterranean Girdle, South Atlantis, Gondwanaland, Oceania, and Antarktis. We are led back to the Archæan Massifs and even to what was before them, and we are briefly reminded of what has been due to cyclic changes such as Ice Ages and Volcanic Periods. The author then passes to the general factors in the Earth's development—the operation of tides (in the widest sense), the deformation of the earth's tetrahedral symmetry, and works backwards to the origin of the hydrosphere and of the lithosphere.

The third section of the book is the constructive historical picture, which begins with the cooling earth and the most ancient continental forms, and works onwards through the geological ages to the present day. There are numerous interesting and suggestive diagrams and maps—showing presumptive pedigrees, the times at which certain races began, and, it may be, ended; what different kinds of creatures were living about the same age, what the distribution of certain races was at different times, what migration-routes were open, and what continental arrangements obtained in successive periods.

A Rational Geography. By Ernest Young. Parts I. and II. 1*s.* 6*d.* each. *Hints on Teaching Geography*, to accompany *A Rational Geography.* By Ernest Young. *Price* 6*d. net.* London: George Philip and Son, 1907.

This book is stated to be primarily intended for the use of schools whose pupils take the Board of Education course in geography, but it is also arranged for other examinations, and each chapter is supplied with examination questions, mostly chosen from among those which have been actually set. The two parts are intended for two successive years of school work, and the series is to be completed by a third part.

Criticism will naturally in the first instance centre round the title, which seems to us difficult to reconcile either with the modesty of the true scientist, who knows no finality, or with that of the true educationalist, who is only too well aware that his best is but an approximation towards the "Rational" method. In our view also the examination fetish bulks somewhat too largely in the present volumes for them to deserve the name of "rational." Again, when confronted with a new text-book, one naturally asks whether it is intended for teacher or for pupil. If for the former, then Method should be dealt with primarily; if for the latter, the book should surely contain a summary of facts which may be used by the pupil for revision after lessons have been given on the subject by the teacher. To our mind the present book, like some others which have reached us lately, suffers from the fact that the author has not clearly made up his mind to which party he desires primarily to appeal. The text throughout contains a great number of questions, often very cogent and practical questions, which will be of great value to the teacher. Such questions the teacher will naturally put in class and will obtain from his class suitable answers. Surely, then, in prescribing a text-book he wants one which can be used by the pupils to revise their class

lesson? The insertion in the book of pieces of information sandwiched among a great number of questions, as in the present instance, seems to us useless, for after all the book cannot replace the teacher.

We have noted a considerable number of inaccuracies. The statement (Part I. p. 20) that in the Swiss Alps snow does not melt above 8800-9000 feet is, as it stands, quite untrue. In the same part (p. 21) the Gulf Stream is stated to make Edinburgh warmer than it otherwise would be. It is true that this friend of our childhood is more coldly treated in Part II., but the author must know that the statement made above is difficult to defend. That oat cake is the staple food of Scotland (Part I. p. 55) is a belief so widely spread across the border that it is perhaps useless to attack it. It is a statement which ceased to be true more than a century ago, and at the present rate of educational progress we have strong hopes that our southern cousins will become aware of the fact in the course of another two hundred years or so. We find ourselves quite unable to discover what the author means by the statement that a lemur is half a monkey and half a squirrel (Part II. p. 180), while it is certainly incorrect to say that lemurs are wholly confined to Madagascar.

But the judicious teacher will find much that is valuable and suggestive in the book, the little pamphlet called *Hints to Teachers* which accompanies it containing especially some sound and practical pieces of advice.

Three Voyages of a Naturalist. By M. J. Nicoll. With an Introduction by the Right Hon. The Earl of Crawford, K.T., F.R.S. Fifty-six plates, four sketch maps and text illustrations. London: Witherby and Co., 1908. *Price* 7*s.* 6*d. net.*

During three cruises with the Earl of Crawford in his yacht *Valhalla*, around the world, to the West Indies, and around Africa, Mr. Nicoll was enabled to visit many out-of-the-way islands, such as the Cayman Islands, St. Paul's Rocks, Fernando de Noronha, South Trinidad, Martin Vas, Tristan da Cunha, and Dassen Island in the Atlantic, Mayotte, Glorioso, Assumption, and Aldabra in the Indian Ocean, and Easter Island, Pitcairn Island, and Tutuila in the Pacific, to cite only some of the places of call. A few of these islands have never before been visited by a naturalist, and most of them but rarely, though Mr. Nicoll is apparently unaware that the *Scotia* made collections at St. Paul's Rocks only eight days previous to his own visit. About each place the author has much to say that is interesting, and, not seldom, new facts of importance to tell us. Heavy surf prevented a landing on Tristan da Cunha, and unfortunately the *Valhalla* did not visit Gough Island, but Mr. Nicoll was lucky in being able to get ashore on St. Paul's Rocks and on Dassen Island, two places where landing is often impossible.

As an ornithologist the author naturally paid most attention to birds, and incidentally it may be mentioned that he secured over eleven hundred skins in the three voyages, including several species new to science, among which a new diving petrel from Tristan da Cunha, and a new tern from South Trinidad, are as interesting as any. We miss, however, almost all reference to birds on the high seas, and would like to have heard more about the prolific bird life in southern seas, and especially about the vexed question of the species of sooty albatroses. But though the author specialised in birds he has many other observations of interest to give us, not the least of which is his account of the "great sea-serpent" that was sighted off Para one morning. A strange fin appeared to them, "a long, eel-like neck surmounted by a head, shaped somewhat like that of a turtle, rose

out of the water in front of the fin." He believes that it was a mammal, not a reptile, though of this we have, of course, no proof, yet a sight of this unknown monster by a naturalist of Mr. Nicoll's standing cannot be ignored, and inspires us with the hope of yet seeing the sea-serpent rescued from the realms of mythology.

The author has written a most delightful volume, and our only regret is that it is not longer. Some of the chapters are tantalisingly short. After reading such fascinating chapters as those, for instance, on the Straits of Magellan, we feel sure that the author must have much worth saying about a score of places which he visited but about which he is silent.

The illustrations could not be better, but the meagre sketch-maps are unworthy of the book.

Circling the Globe by Sea and Land. By JAMES WALKER. London: Henry J. Drane, 1907. *Price* 10*s.* 6*d.*

The reader will find no startling adventures nor hairbreadth escapes recounted in this volume. It is simply the record in journal form of a trip round the world taken by the author, and attended with much the same degree of comfort and safety as any less extended holiday. But the account is pleasantly written, and with the successful intention of conveying information and not merely recording personal impressions. The book naturally is more interesting to the many who have already completed or who contemplate making a similar journey. There are a number of excellent photographs.

NEW MAPS.

EUROPE.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 29th February 1908:—One-inch Map (third edition), engraved, in outline. Sheet 65. Price 1s. 6d.

Six-inch and Larger Scale Maps.—Six-inch Maps (Revised). Full sheets, engraved, without contours. *Sutherland.*—Sheets 32, 33, 46. Price 2s. 6d. each.

1 : 2500 Scale Maps (Revised), with Houses stippled, and with Areas. Price 3s. each. *Berwickshire.*—Sheets I. 16; II. 13, 14, 15; IV. 4, 8, 12, 16; V. 1, 2, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16; (V. 4 and II. 16); (V. 8 and VI. 5); IX. 8; X. 4, 12, 15, 16; XI. 1, 3, 4, 8, 12, 13, 14, 15, 16; XII. 11; XV. 16; XVI. 4, 7, 8, 13, 14, 15; XVII. 4; XVIII. 1, 5, 9, 13; XXI. 4, 8, 12, 16; XXII. 1, 6, 11, 12; XXVI. 12, 16; XXVII. 10, 14, 15; XXVIII. 1, 5, 9; XXXI. 3, 4. Sheets XII. 15; XVIII. (2 and 6); XVIII. (10 and XXIV. 1); XXXI. (1 and 5), 2. Price 1s. 6d. each. *Edinburghshire.*—Sheets IV. 13.

Note.—There is no coloured edition of these sheets, and the unrevised impressions are withdrawn from sale.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st March 1908:—One-inch Map (third edition), engraved, in outline. Sheets 63, 64, 70. Price 1s. 6d. each. Third edition, printed in colours and folded in cover, or flat in sheets. Price, on paper 1s. 6d.; mounted on linen 2s.; mounted in sections, 2s. 6d. each. *Inveraray.*—Sheet 37. *Arbroath.*—Sheet 49.

Six-inch and Larger Scale Maps. Six-inch Maps (Revised), quarter sheets, with contours. Price 1s. each. *Edinburghshire.*—5 NE.

1 : 2500 Scale Maps (Revised), with Houses stippled, and with areas. Price 3s. each :—*Berwickshire.*—Sheets VI. (9 and 10), 13, 14 ; XI. 2 ; XII. 1, 2, 5, 6, 9, 10, 13, 14 ; XVII. 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 ; XXII. 4, 8, 15, 16 ; XXIII. 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14 ; XXVIII. 2, 3, 4, 6, 7, 8, 10, 11, 12, 15 ; XXIX. 1, 2, 5, 6, 9. Sheets XXIII. 8 ; (XXIII. 15 and XXIX. 3) ; XXVIII. 14, 16 ; XXIX. 10 (13 and 14). Price 1s. 6d. each. *Edinburghshire.*—Sheets I. 12 ; IA. 13 ; III. 5 ; IV. 5 ; VII. 1, 2, 3, 4 ; VIII. 1, 2, 3, 9. Sheets I. 9 ; I-B. 16. Price 1s. 6d. each. *Peeblesshire.*—Sheets IX. 1, 5, 10.

Note.—There is no coloured edition of these sheets, and the unrevised impressions are withdrawn from sale.

ADMIRALTY CHARTS, SCOTLAND. TOBERMORY HARBOUR.—Surveyed by Captain W. F. Maxwell, R.N., 1905-6. Scale 1 : 6119. Published 1908. Number 1836 (147). Price 2s.

ORKNEY ISLANDS. HOY SOUND.—Surveyed by Captains H. E. Purey-Cust and W. Pudsey-Dawson, R.N., 1905-6. Scale 1 : 13,714. Published 1908. Number 2568 (261). Price 3s.

Presented by the Hydrographer, The Admiralty, London.

JERSEY.—New Survey Map prepared by J. G. Bartholomew, F.R.G.S., and edited by A. Piquet. Based on the map by R. G. Carrington, F.R.A.S., and latest authorities. Scale 3 inches to a mile. Coloured to show parishes and vingtaines. 1908. *C. P. du Parcq, St. Heliers, Jersey.*

AFRICA.

GOLD COAST.—Map published by the authority of Sir John P. Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1 : 125,000 or about 2 miles to an inch. Sheets 72 L-I., Abetife : 72 Q-I., Dunkwa ; 72 Q-III., Tarkwa ; 73 M-I., Prampram. 1908. Price 2s. each sheet.

W. and A. K. Johnston, Ltd., Edinburgh and London.

AMERICA.

CANADA.—Map of part of the Districts of Nipissing and Algoma, showing townships surveyed near Lake Abitibi. Scale 2 miles to an inch. 1907.

Department of Lands, Forests and Mines, Ottawa.
Presented by Dr. Robert Bell, F.R.S.G.S.

SOUTH AMERICA.—Stanford's New Orographical Map compiled under the direction of H. J. Mackinder, M.A. Scale 1 : 6,000,000 or 94 miles to an inch. In four sheets. 1908. Price in sheets, 16s. ; mounted on rollers and varnished, 20s. *Edward Stanford, London.*

This effective wall-map of South America is uniform in style with the others of the series. Whilst showing the physical features in bold relief, the political features are also included.

BOOKS RECEIVED.

We have received the following new books and reports :—

Slavonic Europe : A Political History of Poland and Russia from 1447 *to* 1796. By R. NISBET BAIN. (Cambridge Historical Series.) Crown 8vo. Pp. viii +452. London : Cambridge University Press, 1908. *Price 5s. 6d. net.*

Spain and Portugal. Handbook for Travellers. By KARL BAEDEKER. With 9 Maps and 57 Plans. Third Edition. Leipzig: Karl Baedeker, 1908. *Price* 16*s.*

Egypt and how to see It. Illustrated by A. C. LAMPLOUGH. Crown 8vo. Pp. 208. London: Ballantyne and Co., Ltd., 1908.

The Elements of Geography. By J. H. N. STEPHENSON, M.A. Crown 8vo. Pp. xiii + 160. London: Edward Stanford, 1908. *Price* 3*s.* 6*d.*

Handbook for Rome and the Campagna. Edited by NORWOOD YOUNG. Seventeenth Edition. With 96 Maps and Plans. (Murray's.) London: Edward Stanford, 1908. *Price* 10*s.*

Highways and Byways in Hampshire. By D. H. MOUBRAY READ. With Illustrations by ARTHUR B. CONNOR. Crown 8vo. Pp xx + 444. London: Macmillan and Co., Ltd., 1908. *Price* 6*s.*

Leon, Burgos and Salamanca: A Historical and Descriptive Account. By ALBERT F. CALVERT. With 462 Illustrations. Crown 8vo. Pp. xxvi + 151. *Price* 3*s.* 6*d. net.* London: John Lane, 1908.

A Trip to Pilawin, the Deer-Park of Count Joseph Potocki in Volhynia, Russia. By R. LYDEKKER. Crown 4to. Pp. xiv + 115. London: Rowland Ward, Ltd., 1908. *Price* 6*s. net.*

La Colombie Britannique: Étude sur la colonisation au Canada. Par ALBERT MÉTIN. Un volume in 8° raisin. Pages 440. *Prix* 12 *fr.* Paris: Librairie Armand Colin, 1908.

The World's People: A Popular Account of their Bodily and Mental Characters, Beliefs, Traditions, Political and Social Institutions. By A. H. KEANE, LL.D., F.R.A.I. With 270 Illustrations. Demy 8vo. Pp. xii + 434. London: Hutchison and Co., 1908. *Price* 6*s. net.*

Kelatan. A State of the Malay Peninsula. A Handbook of Information. By W. A. GRAHAM. Crown 8vo. Pp. xi + 139. Glasgow: Maclehose, 1908. *Price* 5*s. net.*

Southern Italy and Sicily, with Excursions to Malta, Sardinia, Tunis and Corfu. Handbook for Travellers. By KARL BAEDEKER. With 30 Maps and 28 Plans. Fifteenth Revised Edition. Pp. liv + 488. Leipzig: Karl Baedeker, 1908. *Price* 6*s.*

The Book of Ceylon: Being a Guide to its Railway System, and an Account of its Varied Attractions for the Visitor and Tourist. By HENRY W. CAVE, M.A. (Oxon.), F.R.G.S. Illustrated from Photographs by the Author. Royal 8vo. Pp. xvi + 664. London: Cassell and Co., Ltd., 1908. *Price* 12*s. net.*

Ice-Bound Heights of the Mustagh: An Account of Two Seasons of Pioneer Exploration and High Climbing in the Baltistan Himalaya. By FANNY BULLOCK WORKMAN, Officier de l'Instruction Publique de France, etc., and WILLIAM HUNTER WORKMAN, M.A., M.D., F.R.G.S. With 2 Maps and 170 Illustrations. Royal 8vo. Pp. xvi + 444. *Price* 21*s. net.* London: Archibald Constable, 1907.

The Story of the Guides. By Colonel G. J. YOUNGHUSBAND, C.B. With Illustrations. Demy 8vo. Pp. xvi + 207. London: Macmillan and Co., 1908. *Price* 7*s.* 6*d. net.*

Sport and Life on the Pacific Slope. By HORACE ANNESLEY VACHELL. Demy 8vo. Pp. xii + 340. London: Eveleigh Nash, 1908. *Price* 7*s.* 6*d. net.*

The Soul of Spain. By HAVELOCK ELLIS. Demy 8vo. Pp. x + 420. London: Archibald Constable, 1908. *Price* 7*s.* 6*d. net.*

Sketches from Life in Town and Country. By EDWARD CARPENTER. Crown 8vo. Pp. vi + 273. London: George Allen, 1908. *Price* 5*s. net.*

The Uplift of China. By Dr. A. H. SMITH. Crown 8vo. Pp. xi + 325. Edinburgh, Foreign Mission Committee of Church of Scotland, 1907.

Daybreak in the Dark Continent. By Wilson S. Naylor. Crown 8vo. Pp. xvi + 315. Young People's Missionary Movement: New York, n.d.

[*Presented by G. H. Oldham, Esq.*

The Passing of Morocco. By Frederick Moore. With Illustrations and Map. Crown 8vo. Pp. xiv + 188. *Price* 5*s.* London: Smith, Elder and Co., 1907.

The Mongols: A History. By Jeremiah Curtin. With a Foreword by Theodore Roosevelt. Demy 8vo. Pp. xxvi + 426. *Price* 12*s.* 6*d. net.* London: Sampson Low, Marston and Co., 1908.

Also the following Reports, etc. :—

The Geology of the Coromandel Subdivision, Hauraki, Auckland. By Colin Fraser, assisted by James H. Adams. New Zealand Geological Survey. Bulletin No. 4. Wellington, 1907.

Verhandlungen des Sechszehnten Deutschen Geographentages zu Nürnberg. Berlin: Dietrich Reimer, 1907.

Report on the British Indian Commercial Mission to South-Eastern Persia during 1904-1905. By A. H. Gleadowe-Newcomen, F.R.G.S., F.S.A. Calcutta, 1906.

Report relating to the Geology of the East Africa Protectorate. By H. Brantwood Muff, B.A. Pp. 63. *Price* 6*d.* Colonial Reports. London, 1908.

Heaton's Annual: The Commercial Handbook of Canada and Boards of Trade Register. Fourth Edition, 1908. Crown 8vo. Pp. 380. *Price* 4*s.* Toronto: Heaton's Agency, 1908.

Report on the Administration of the Madras Presidency during the Year 1906-1907. Madras, 1907.

The Falls of Niagara: their Evolution and Varying Relations to the Great Lakes, Characteristics of the Power, and the Effects of its Diversion. By Joseph W. W. Spencer, M.A., Ph.D., F.G.S. Pp. xxxii + 490. Department of Mines, Geological Survey Branch, Ottawa, 1907.

Punjab District Gazetteers, 1904. Vols. x^a, $xxvii^a$, $xxvi^b$. Lahore, 1907.

Baluchistan District Gazetteers. Vols. i., ii., vii. and viii. Bombay, 1907.

Report of the Seventy-seventh Meeting of the British Association for the Advancement of Science, Leicester. London, 1908.

A Report on the Delimitation of the Turko-Egyptian Boundary between the Vilayet of the Hijaz and the Peninsula of Sinai. By E. B. H. Wade, with additions by B. F. E. Keeling and J. I. Craig. Cairo, 1908.

Report on the Administration of the Bombay Presidency for the Year 1906-1907. Bombay, 1908.

Report on the Administration of the Civil and Military Station of Bangalore for the Year 1906-1907. Bangalore, 1907.

Report on the Administration of the United Provinces of Agra and Oudh, 1906-1907. Allaho.

Lecture des Cartes Anglaises et des Etats-Unis. Indications linguistiques, géographiques et topographiques. Par Capitaine P. Pollacchi. 4to. Pp. 158. Paris: Librairie Militaire R. Chapelot, 1908.

The White Nile and the Cotton Crop (No. 2). By Sir William Willcocks, K.C.M.G., F.R.G.S. Pp. 18. Cairo, 1908.

The Canada Year-Book, 1906. Second Series. Pp. xlvi + 515. Compiled by Archibald Blue, Census and Statistics Office. Ottawa, 1907.

Publishers forwarding books for review will greatly oblige by marking the **price** *in clear figures, especially in the case of foreign books.*

THE SCOTTISH

GEOGRAPHICAL

MAGAZINE.

THE REPUBLIC AND CANTON OF GENEVA.

A DEMOGRAPHICAL SKETCH.

By Victor Dingelstedt, Corr. Memb. R.S.G.S.

(*Continued from page* 238.)

Vital Statistics.

Marriages.—Marriages between persons of all the different elements of population are certainly one of the main binding factors, creating also a new mixed blood with probably a favourable result for the worth of the new generations. A Genevese intermarries as often with a confederate or foreigner as with a person of his own race. As in all prosperous communities, the marriage-rate is on the increase. At the beginning of last century the mean average annual marriage-rate was 6 per thousand of the inhabitants of both sexes; it is now almost double, viz. 10 per thousand. It is less than in England (16 per thousand), but more than in France (7·6 per thousand). For each hundred marriages there are on the average 37 per cent. when both or one of those concerned are native; 30 per cent. concerning only foreigners, and 33 per cent. the confederates. It is on the average only in 36 cases out of each hundred that a Genevese husband takes his wife from among his own race, in 27 other cases he marries a Swiss woman of other cantons, and in 37 cases a foreign woman, so there is a very strong mixture of foreign blood in the veins of the existing Genevese.

The mean annual rate of persons married to the number of marriageable, that is, to single persons of from twenty to fifty years of age, is about 4·6 per cent., about the same as in England (from 3·6 to 5·5 per cent.). A tendency to postpone marriage is increasingly visible. The legal marriage age is for men eighteen, and for women sixteen years. The marriage-rate is highest in the June quarter of the year; it is lowest

in the winter quarter: the average difference being at about 3·2 per thousand living.

Divorces.—With the increase of the number of marriages, and the decrease of their fecundity, we observe also an increase in the divorces. For each thousand marriages there was in the first half of the last century about 2 per cent. of divorces; at the present time it is five and even six times as much. In Geneva the average annual number of marriages is 716, and the average number of divorces is 101. The divorces take place usually among young people.

Marriages in Relation to the Birth-rate.—Whilst the respective number of marriages increases—and, as we have seen, the figure has almost doubled in the canton under consideration—the fecundity of the marriages tends constantly to decrease, and in the course of a century it has fallen by a half—from 4 to 2 births on the average. This figure is falling still lower in our day, and for the native element each ten marriages give now only on the average 17 births. This rate is far below that of England, and even of France, where each ten marriages give on the average respectively 37 and 27 births.

Sex and Civil Status.—A peculiarity of the population of Geneva is the marked preponderance in numbers of females over men. While the proportion of women to men in the whole of Switzerland is as 100 to 96, and in England 100 to 94, in the Canton of Geneva for every 100 women there are only 86 men for the total population, and 84 for its Swiss portion. It is noteworthy that the proportion of sex for some Asiatic and other countries is just the reverse of what is just stated. For every 100 men there are in Trans-Caucasia 85 women, in St. Petersburg 82, in Sukhum 78, in the Black Sea Government 67.

In Geneva the proportion of men to women has gone on decreasing for more than half a century. In 1850 there were registered 92 men against 100 women. It is probable that this deficit of males is one of the causes of the weakness in the birth-rate, as will be indicated later.

We give the percentage of minors, zero to nineteen years, single, married, widowed and divorced, in each of the three sections of the population of Geneva.

	Genevese.		Confederates.		Foreigners.	
	Men.	Women.	Men.	Women.	Men.	Women.
Minors . . .	31·2	24	34·7	29	31·4	29·4
Single	20·8	20	23	28·4	27	25·5
Married . . .	43·3	40	39	32	39	35·5
Widowed . . .	4	14·4	2·5	8·8	2·5	9
Divorced . . .	0·7	1·6	0·7	1·8	0·1	0·6
	100	100	100	100	100	100

Boys are more numerous than girls; there are more married men than women, because the first die earlier, and consequently as in England there are far more widows than widowers. The number of

divorced women is more considerable than of divorced men, probably because the last re-marry or die earlier. The women being in greater number have a lower percentage of married. For the last fifty years the number of bachelors and widowers has decreased, whereas that of married has correspondingly increased. In comparison with England the proportion of wives is the same, while in Geneva there are relatively more husbands. The unmarried form 60·3 per cent. in England, and only 52·2 per cent. in Geneva.

Age.—The distribution of a population according to age has always importance, as it is only at a certain age that a man is capable of working, and sustaining by this work himself and those who depend on him and are under or over age; but it has a special importance in those small countries, whose independent existence depends mainly on the number of persons capable of bearing arms and defending their home against foreign invasion. There are four periods of life of special importance:—*Babyhood* up to four years, when so much pains must be taken to preserve from destruction a delicate life; *Childhood* from four to nineteen years, when one is only learning life and preparing oneself for the real work of earning one's living; *Manhood* from twenty to sixty-five or seventy; *Old Age* when one is dependent, having lost the strength to work.

It is not easy to classify a nation according to age, the data being usually rare and not quite reliable. There are at our disposal only the census carried out every decade by the Federal Government, and some data by the Cantonal Office of Statistics concerning school children. It is also possible to calculate with approximate accuracy the number of persons of a given age from the death-rolls, on which is indicated the age of the deceased.

With the aid of these various sources of information the following conclusions have been arrived at. The total number of persons of both sexes of unproductive age or childhood, constitute 30 per cent. of the total population of the canton in all its three elements. There are more boys than girls; the disproportion is 2 per cent. for foreigners and 5 per cent. for the indigenous population (31 per cent. of boys and 26 per cent. of girls).

In the number of the non-adult population, a little less than one-third is in prime infancy or babyhood. This number is slowly increasing with the progress of puericulture. The adult population works out at 70 per cent. of the total, but to obtain the number of persons of productive age it is necessary to deduct from the above the number of those who have attained or passed seventy years of age and are no longer capable of working; the productive population is thus reduced to about 66 per cent. of the total.

This percentage varies according to sex and nationality. In the indigenous population for each 1000 there are 323 adult men and 397 adult women. In the confederates respectively 298 and 397, and among the foreigners 325 and 398; thus the greatest disproportion is among confederates and the least among foreigners, being in the first case as 75 to 100, and in the last as 81 to 100. This large pre-eminence of the female adult population must certainly exercise considerable influence

in social, industrial, and commercial life, and would certainly effect a very great revolution in politics if the women obtained the right of suffrage.

The number of men twenty years old liable to military service in Switzerland has decreased from 27,256 in 1896 to 26,808 in 1907. Corresponding to the slight increase in infants in the last half century, there is a slight decrease in the percentage of the adult population for the same period of time—that is, the burden of maintaining the family has become heavier.

Births.—An increase in the number of births was formerly considered as indicating an increase in prosperity, but there are now reasons to believe just the contrary, as many statistics show a decline of the birth-rate with increase of prosperity.

This seems to be plainly the case with the population of Geneva. There is no doubt that the general prosperity of the canton, which is the object of our research, is in constant and almost uninterrupted increase; its commerce, its trade, its population, its public property have doubled and trebled in a relatively short period of modern time, yet its birth-rate is continually and regularly decreasing, and that to quite an alarming degree. The number of births, marriages, and deaths is believed to vary with the state of trade, price of food, and the seasons; it depends also on occupations, and probably on a very great number of other yet unknown factors. The birth-rate among the native part of the population was 36 per thousand in the first half of the seventeenth century; it decreased to 30 per thousand at the end of the same century, and since then by gradual descent it has arrived in our time, among the indigenous part of the population, to the very low figure of only 15·6 per thousand (3 per thousand below the death-rate). The average number of births for each marriage is 1·7 (England 3·74).

It is not easy to account for such an alarming sterility in a wealthy and prosperous population. It is admitted that the birth-rate depends: (1) on the prolificness of marriages, (2) the proportion born which lives to marry, and (3) the interval between the mean age of marriage and the mean age of death.

As we shall see, all these conditions are unfavourable in the native part of the Genevese population.

The average birth-rate for the two other elements of the population is considerably higher: it is 22·6 per thousand for confederates and 23·2 for foreigners. These figures, however, are much below those of England, where the birth-rate is also decreasing—from 34 per thousand in 1890, 29·5 in 1900, to 27 per thousand in 1906, and especially below Germany with a birth-rate of 35 per thousand.

The birth-rate in France is also falling off rapidly, from 31 per thousand in 1830 to 21 per thousand in our days. It is only 20·8 per thousand for Paris, whilst London has a rate of 35·6 per thousand in poor quarters, and almost only half of it, 18·6 per thousand, in its rich quarters. The same phenomenon has been observed in all other large cities—Paris, Berlin, Vienna—the birth-rate of the rich classes is only about one-half of those of the poor, or, in other words, poor people have twice as many children as the rich. There is also a steady fall in the

birth-rate in Germany, from 40·7 per thousand in 1870-80, and 37·4 per thousand in 1891-1900, to 34 per thousand in 1905.

Climate does not seem to exercise any considerable influence on the birth-rate. We have taken seventeen great towns with a maximum average birth-rate of 34·2 per thousand, and seventeen others with a maximum average rate of only 20·3 per thousand. Notwithstanding this considerable difference in fecundity the average mean annual temperature of each of the two groups of the cities is in the first case 55·1° F., and the second 56° F.

In the first half of last century a Genevese author, Ed. Mallet, in his statistical work on Geneva (1833) said that the fecundity of women was then at its lowest, and yet since that pronouncement the population of Geneva has increased about 330 per cent., and the fecundity of women considerably decreased, from a rate of 40 to a rate of 27 per thousand women.

What then are the reasons for this alarming decrease of fecundity in Geneva? In nature the fecundity increases proportionately to the intensity of the struggle for existence, and it diminishes when, as is actually the case among the old, orderly, prosperous population of Geneva, there are many conflicting interests and ambitions, but almost no struggle for existence in the true sense of the word. Besides, the existing struggle has changed in its natural character; it no longer involves as of yore the correspondent development of men's physical faculties, but on the contrary a physical degeneration. There also seems to exist another potent cause of the actual decrease of birth-rate among most civilised nations which has received the name of prudential restraint, or Determining Element,[1] and it is affirmed that in the actual state of competition the question of more or less children is almost synonymous with the question of life or death. Many other reasons have been adduced by competent investigators to account for the decrease of the birth-rate.

According to Mr. Doubleday it may be attributed to the fact of people eating too much nowadays; he says, "when men and women eat more they breed less." According to Mr. Paul Leroy-Beaulieu the diminished birth-rate is due to the impairment of the old faiths, the development of luxury, family ambitions, adventurous careers, increasing difficulties in attaining lucrative posts early in life, and feminism.

In Geneva one reason may be also the small proportion of men.

Mr. Metchnikoff affirms that the restriction of the reproductive instinct is the chief means of diminishing the most brutal forms of the struggle for existence, and of increasing morality.

Boys and Girls.—It seems to be a universal law that boys are born in greater number than girls. In the Canton of Geneva from 5 to 8 per cent. more males than females are born, and this proportion has not much varied for centuries.

In England about 4 per cent. more boys than girls are born.

Legitimate and Natural Children.—The present law makes as yet the cruel distinction between children born in and out of wedlock—a distinction unknown in Mussulman countries; and yet, notwithstanding the

[1] Mr. Montague Crackanthorpe, "Population and Progress," *Fortnightly Review*, 1906.

unjust stigma attached to persons born out of wedlock, their number is continually increasing. From 7 per cent. in the first half of the last century, it has risen to 12 per cent. in our time. And this figure is very probably below the reality.

In England the number of children born out of wedlock is about 6 per cent. of the total births.

Death-Roll.—One of the most important preoccupations of mankind should be to prolong individual existence to its farthest limits, from which certainly would accrue an immense benefit to the community. The general enlightenment reached by the Canton of Geneva could not fail to bring about a decrease in the average annual death-rate and an increase of mean average life.

The death-rate of from 30 to 35 per thousand living, as it was in the seventeenth century, had gradually fallen to 24 per thousand in the first half of the last century, and is 18 per thousand in our days.

This phenomenon of decreased mortality is observable in the whole of Switzerland, where the annual death-rate has fallen from 27·4 per thousand in 1896 to 19·9 per thousand in one decade, as it has also to even a higher degree in Great Britain and especially in England, where the death-rate in 1907 reached the lowest figure ever recorded in any quarter, viz. 12·1 per thousand.

Mortality in relation to Age.—If considered separately for the different elements composing the population of Geneva, it seems that mortality is relatively highest among the native portion and lowest among the confederates (19·1 per thousand).

Naturally the mortality depends mainly on the age, occupation, sex, and sanitary conditions. It is highest among old people over seventy and among babies under one year; it is lowest from the age of eleven to fifteen. It increases gradually from fifteen upwards to the end of life. Between forty and forty-nine the average death-rate is about the same as the general death-rate.

We give the mortality table at different ages for all the three elements of Genevese population in relation to each thousand of living of both sexes:—

Age.	Natives.	Confederates.	Foreigners.
Stillborn	18	40	43
Under 1 year	74	70	123
From 1 to 2	13	13	22
„ 3 to 5	6·2	5	8·6
„ 6 to 10	3.	5·4	5·4
„ 11 to 15	2·9	2·3	3·4
„ 16 to 20	3·1	7·5	5·8
„ 21 to 30	6	11	9
„ 31 to 40	9	18	12
„ 41 to 50	15	20	13
„ 51 to 60	34	26·6	24
„ 61 to 70	50	37	28
„ 71 and above	130	76	45

In comparison with England the infant mortality in Geneva seems to be lower. The mortality in the first twenty years of life among the different elements of the population of Geneva is twice as high among confederates and foreigners as among the native population.

The number of stillborn tends continually to decrease. It was above 10 per cent. of the total births in the first half of the last century, and is now under 2 per cent. among the native, and a little above 4 per cent. among the other elements of the population.

The greatest percentage for each hundred persons deceased falls naturally among the aged, and this percentage is the greater the lower is the premature mortality rate : thus among natives the death-rate at the age of sixty-one and upwards is almost double the figure representing the percentage of dead at this high age among foreigners ; whereas, on the contrary, the percentage of dead at the tender age of babies up to five years is more than twice as high among the foreigners and confederates than among natives. This indicates very strongly the more powerful constitution and the greater longevity of the native Genevese race as compared with foreigners and even the other Swiss population of the canton. The percentage of dead at mature age from twenty-one to fifty is almost the same among all the three elements of population. There are far less stillborn among the natives, which is another item in their favour.

The next table shows the percentage of deceased according to age and sex. It shows that the mortality is higher among the females up to thirty years, and it is then lower than that of the males till the end of life.

TABLE SHOWING THE NUMBER OF DEATHS PER CENT. ACCORDING TO AGE AND SEX OF ALL THREE ELEMENTS OF GENEVESE POPULATION.

Age.	Native.		Confederates.		Alien.	
	M.	F.	M.	F.	M.	F.
0 to 1 . .	20·3	24·3	30	33	41	44·5
2 to 5 . .	6·3	6	7·9	8·6	10	11·6
6 to 30 . .	13·7	4·6	9	9·3	7	8·6
31 to 60 . .	17	15·6	20·5	20	14	14·3
61 and upwards .	52·7	49·5	32·6	29·1	28	21
	100	100	100	100	100	100

Among the natives the mortality is highest in old age in both sexes from sixty-one and upwards ; among the confederates the mortality is almost the same at both extreme ages ; whereas among the aliens the highest mortality of both sexes is at the most tender age. Mortality is higher among male than among female infants up to four and five years, when it is almost equal among both sexes up to twenty years of age, when it is again higher for the male sex ; and this great mortality goes always

increasing up to the end of life, with a difference in favour of women of about 23 per cent.

Death-rate versus Birth-rate.—Almost everywhere in more or less prosperous human communities in the world there is an excess of births over deaths, and in many civilised states this excess is considerable, amounting to 36 per cent. in Russia, 42 per cent. in Prussia, 45 per cent. in England. But it is not so for the native Genevese population. Already in the eighteenth century its death-rate was about 2 per cent. higher than its birth-rate. But in our time this unfavourable proportion has further increased. For the period of sixteen years (from 1892 to 1907) 15,114 cases of deaths, and only 11,392 cases of births among the natives have been registered, so that there is an excess of deaths of 3722, or nearly 233 per annum. It is true that about 290 deaths occurred among naturalised persons whose births could not be registered in Geneva, yet there is nevertheless a deficit of 3432 per sixteen years, occasioned by the predominance of the death over the birth-rate.

The case is not quite unique, for in some French communities, as also in Massachusetts in the communities of native American descent, as also probably elsewhere, the birth-rate has fallen below the death-rate; but it is nevertheless highly remarkable, and the more so that it concerns a well-to-do, enlightened, and prosperous community of a strong and vigorous race.

As to the other ethnical elements of Geneva population, as we have seen, there is excess of birth above death-rate of about 27 per cent. among confederates, and a little less (24 per cent.) among foreigners.

Influences of the Season.—The season exercises a potent influence equally on birth and death-rates, and therefore merits special attention. It is even affirmed by some that this influence is greater than all other natural and human influences taken together.

Quarterly Birth-rates per 1000 Living.

	Genevese.	England.	Death-rates.	Marriages.
In March . .	20 per 1000	35·4	22	263— 7·6 per 1000
„ June . . .	18·4 „	35·1	19·1	358—10·4 „
„ September . .	19·6 „	32·5	15·6	307— 8·2 „
„ December . .	18·8 „	32·3	16·8	334— 9·6 „
Annual .	18·6		17·3	

The marriages are the more frequent in June quarter.

	Birth-rates.			Death-rates.		
	G.	C.	F.	G.	C.	F.
First quarter	15·2	26·0	21·6	21·2	21·2	20·9
Second quarter	14·4	24·4	21·6	17·4	19 6	17·6
Third quarter	14·6	24·0	21·6	15·2	16·8	16·
Fourth quarter	13·2	24·0	19·6	16·9	17·6	15·2
	Maximum in the first quarter. Minimum in the fourth quarter.			Maximum in the first quarter. Minimum in third and fourth quarter.		

Birth-rate is the highest in the March and September quarters of the year; it is lowest in the December quarter, the difference between the maximum and minimum being 2 per thousand living. Considered separately for each of the three elements of the population, the birth-rate is the lowest in the last quarter of the year for native people, being only 13·2 per thousand; it is highest for the confederates in the first quarter, being almost double the last figure (26 per thousand). There is but a small or no difference in the quarterly birth-rate between the second and last quarters. There are always born more boys than girls in every quarter of the year with a very small exception to this rule. In England February is the month in which the greatest number of births occur, June the month in which occur the fewest.

The death-rate is by far the highest in the March and in the June quarters of the year; it is the lowest in the summer quarters; it varies much according to the season, the maximum being 4·4 per thousand higher than the minimum. In the first quarter of the year the death-rate is considerably higher than the birth-rate. Considered separately for each of the three different elements of population, the death-rate is invariably higher in the first quarter; it is lowest for the Swiss elements in the summer quarter, and for the foreigners in the last or December quarter. In all quarters of the year there is a preponderance of births over deaths except for the native portion of the population, among which it is the contrary—the death-rate in all quarters of the year is higher than the birth-rate, the difference on the wrong side being greatest in the March quarter, when there is a loss of 6 per thousand, and smallest in the September quarter, when the birth and death-rates are respectively 14·6 and 15·2 per thousand—that is, a loss of only 0·6 per thousand of living.

As already stated, the climate does not seem to exercise any considerable influence on the birth-rate; but it is not so with the death-rate. Here the influence of climate is undeniable. Death-rate depends on a great many factors, but mainly on sanitary conditions of life, and these conditions are more easily obtainable in moderate or cold climates than in warm ones, without considering that the north has developed a higher civilisation than the south. Taking two series of the most renowned cities, the one with a minimum death-rate not above 18 per thousand living,[1] the other with a maximum above 30 per thousand,[2] we see that the most southerly town of the first series, viz. Sydney, lies on latitude 32° 52′ S., after that St. Louis, 40° lat. N., whilst the most northerly town of the second or bad series, viz. Rouen, lies on lat. 49° N.; that is, there is no town to the south of 40° lat. that enjoys a minimum mortality under 18 per thousand, except Sydney.

The twelve cities with the highest death-rate, taken together, have a mean average annual temperature of 64° F. (from a maximum 81·9°,

[1] Berlin, Amsterdam, Antwerp, Bradford, Brighton, Bristol, Brussels, Chicago, Christiania, Copenhagen, Dresden, Hamburg, Hague, London, St. Louis, U.S., Stockholm, Sydney.

[2] Alexandria, Algiers, Cairo, Calcutta, Madras, Madrid, Mexico, Naples, Rouen, Valparaiso, Bombay, Montreal.

Madras, to a minimum 42·8°, Montreal), whereas the seventeen cities with the lowest death-rate have together a mean average temperature of 50° F. (from 63°, Sydney, to 41·4°, Stockholm). The cities with the lowest death-rate belong to England, Holland, Belgium, Denmark, Saxony, and United States; the cities with the highest death-rate belong to Egypt, India, Spain, Italy, Chili, Canada, and United States.

Conclusion.—In conclusion of this study, which though very imperfect has yet required a considerable amount of research, the writer would ask leave to hazard some prognostics as to the future of this westernmost corner of Switzerland.

The town of Geneva, thanks to the efforts of past generations and its culture, beautiful situation, and sanitary conditions, has already acquired sufficient importance to be sure of a continual growth and prosperity, but in our days the material progress of a city depends mainly on its being or not being on the main international lines of communications.

These main lines of communications are now determined by the railway systems, which are more and more independent of geographical situation and natural obstacles. With the creation of a new road between Western Europe and Italy through the tunnel of the Simplon, Geneva is no more on the main line, and will not find itself again in this privileged situation until the piercing of a new tunnel through the neck of the Faucille, on the Jura, in the direction of Dijon and Paris.

The Canton of Geneva is quite ready to make considerable sacrifices for the realisation of this considerable undertaking, which would greatly facilitate commerce and the movement of tourists between Western Europe and Italy; but railway politics depend here entirely on the counsels prevailing in Berne, and there the influence of Geneva is far from being preponderate.

Failing this, there is some reason to apprehend that Geneva will find it increasingly difficult to manage its already involved finances in a way to satisfy the always rising requirements of a model modern city, and to diminish its death-rate as the sole disposable means for maintaining in number its native population. Whatever may be the future, it is certain that the tourists of all the world are interested in the further prosperity and development of such a beautiful corner of the earth as the Republic and Canton of Geneva, so valiantly endeavouring to live up to its noble device: *Post Tenebras Lux: Nous maintiendrons.*

BATHYMETRICAL SURVEY OF THE FRESH-WATER LOCHS OF SCOTLAND.[1]

Under the Direction of Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., etc., and LAURENCE PULLAR, F.R.S.E.

PART XIII.—LOCHS OF THE NESS BASIN.

THIRD PART.

THE first part of this paper, published here in April (p. 187) last, dealt with the physical features of Loch Ness, and the second part, published here in May (p. 238), dealt with twenty-seven of the tributary lochs. This third part includes the descriptions of the remaining five lochs, with notes on: I. The temperature of the water in Loch Ness, with a footnote on the chemical composition of the water; II. the seiches of Loch Ness; III. the deposits of Loch Ness; IV. mirages on Loch Ness; V. "storm-weather" at Fort Augustus; VI. the geology of the Ness district; VII. the biology of the lochs in the Ness basin; and VIII. the aquatic vegetation of the lochs in the Ness basin.

Loch Mhor.—Loch Mhor is the reservoir for the British Aluminium Co.'s works at Foyers. In its construction advantage was taken of two natural lochs (Garth and Farraline). By means of the dam at the lower end of Loch Garth, the surface of Loch Mhor may be raised to 20 feet above the original level of Loch Farraline, the upper loch. In summer the two lochs may subside to their original levels. The loch is still divided into two portions by a causeway two miles from the upper end, and a public road here crosses by a bridge, the water passing by a canal underneath. The loch is rapidly forming a beach by eating away the boulder clay of the fields. These raw cliffs of clay are exposed when the loch is below its high level, and portions are continually falling in.

Loch Mhor is of very irregular form, narrow and elongate, running north-east and south-west in Strath Errick, the lower end some two miles south-east of Foyers. On the west the country is moorland, with low hills, and many patches of trees on the shore of the loch. On the east the hills are higher, rising to mountains at the distance of a few miles. The west shore-line is of a simple outline, with slight double sigmoid curvature. The east shore is much broken up, several bays and arms running south-eastward. The largest of these is in the middle of the loch, and runs three-quarters of a mile inland.

The loch is nearly 5 miles in length, has a maximum breadth of nearly three-quarters of a mile, and a mean breadth of one-third of a mile. It has a superficial area of $1\frac{2}{3}$ square miles. The volume of water is subject to great variation, being estimated at the date of the survey

[1] Abbreviated from a paper, with maps and figures, in *The Geographical Journal* for January 1908.

(April 24 and 25, 1903) at 1134 millions of cubic feet. It drains an area of about 21 square miles. Few streams of any importance enter the loch. The largest are the Allt na Seabhaig, which formerly flowed into the river Gourag, but was diverted into Loch Garth when the dam was built, and the Aberchalder burn, which enters the large middle bay on the east. When quite full the reservoir overflows into the Gourag. When surveyed the surface was 638·5 feet above sea-level. In accordance with its artificial origin, the greater part of Loch Mhor is very shallow; deep water is only found in the original natural lochs. Two-thirds of the whole area is less than 25 feet deep.

The basin formed by Loch Farraline before the surface was raised was fully a mile in length, and one-third of a mile broad, with a depth of about 40 feet. The breadth has been very little increased by the dam. The depth is now 60 feet. The basin is simple, with uniform contours and gently sloping sides. The 25-feet contour encloses an area of two-thirds of a mile long by one-fifth of a mile broad. The 50-feet area is very narrow, a quarter of a mile long, and a little east of the central line.

The basin of Loch Garth, which was 1½ miles long by nearly half a mile broad, is of irregular shape. The main part of the loch was oblong, but a long, curved, narrower part branched off to the south. The depth is now 91 feet (the maximum for Loch Mhor). The 25-feet contour almost coincides with the shore-line of the original loch. The 50-feet contour encloses an area 1¼ miles in length, and enters the narrow southern branch. This area is broad for half a mile at the north end, but from there south it is a narrow channel. The 75-feet area is one-third of a mile long by one-fifth of a mile broad. The mean depth of the whole loch is 24 feet.

Series of temperatures were taken in Loch Garth on April 24, and in Loch Farraline on April 25.

	Loch Garth, April 24, 1903.	Loch Farraline, April 25, 1903.
Surface	42·0° Fahr.	43·5° Fahr.
10 feet	41·8° ,,	43·2° ,,
25 ,,	... ,,	43·0° ,,
30 ,,	... ,,	42·4° ,,
40 ,,	41·2° ,,	42·0° ,,
55 ,,	... ,,	42·0° ,,
80 ,,	41·2° ,,	... ,,

Loch Bran.—Loch Bran is situated in the woods above Foyers, from which it is a mile distant. The shores are wooded, with rock showing in places a little way from the water's edge. There are really two basins at the same level, separated by a narrow neck of land. The loch is very narrow, with the centre line strongly curved. Its length, measured in a straight line, is about three-eighths of a mile, measured round the curve nearly three-quarters of a mile; the maximum breadth is one-fifth of a mile. The superficial area is about 24 acres, and the volume of water 13 millions of cubic feet. The drainage area is only a quarter of a square mile; the loch receives no streams of any size. The east loch

drains into the west loch, and that into the river Foyers by a burn half a mile long. The east loch is much the larger and deeper, but the deep area with a maximum of 50 feet is only a little hole in the middle of the loch. The greatest depth in the west loch is 19 feet. The mean depth of the whole loch is 12½ feet. The temperature at the surface on April 30, 1903, was 48·6° Fahr.; at 10 feet, 46·2°; at 20 feet, 45·0°; at 25 feet, 42·3°; and at 50 feet, 42·2°.

Loch a' Choire.—A little loch lying between Lochs Duntelchaig and Ruthven, and draining into the latter. Low but craggy hills border the loch on the west and north, the crags of Creag Dearg facing the west end. The loch is of somewhat oblong form, with the long diameter east and west. The length is nearly two-thirds of a mile, the greatest breadth one-third of a mile, the mean breadth one-fifth of a mile. The superficial area is about 86 acres, and the volume of water 103 millions of cubic feet. The drainage area is nearly one square mile. Only one stream, the Allt Bhreac, flows in on the north, and at the east end the burn flows out towards Loch Ruthven.

Loch a' Choire is 865 feet above the sea. The bottom forms a simple basin, with the deeper water towards the east end. The 25-feet contour follows the shore-line, except at one point on the north where a sounding of 18 feet lies far out. The 50-feet area, one-sixth of a mile in length, lies all to the east of the centre of the loch. The maximum depth is 60 feet, and the mean depth 27½ feet. The temperature at the surface on April 28, 1903, was 43·5° Fahr.; at 25 feet, 42 5°; and at 50 feet, 42·5°.

Loch Ruthven.—A loch of fair size, some 2½ miles east of Loch Ness, opposite Urquhart bay, and half a mile south of Loch Duntelchaig. It is a narrow loch, with its central line much curved, but having its general direction east to west. Precipitous wooded hills, the Torr Mòr and the Torr Beag, rise abruptly from the north shore. On the south the crags of Stac Gorm and Craig Ruthven border the eastern part of the loch, while towards the west the ground is lower and more open.

Loch Ruthven is very narrow in the middle, slightly expanded at the east, and much expanded at the west end. The length is 2¼ miles, the maximum breadth, close to the lower end, fully half a mile, and the mean breadth a quarter of a mile. It has a superficial area of about 368 acres, or over half a square mile, and a volume of 180 millions of cubic feet. The drainage area is 4 square miles. The burn from Loch a' Choire comes in near the upper end of the loch, and there are no other burns of any size. The outflowing stream is the river Farigaig, which falls into Loch Ness at Inverfarigaig.

When surveyed on April 27 and 28, 1903, the loch was 2 feet below a bench-mark, 703·1 on the south shore at the upper end, and would therefore be 701·1 feet above the sea. This figure is at variance with two spot-levels on the north shore where 687 and 688 feet are marked near the west end, and there is no dam to account for so much differ-

ence. The Ordnance Survey, on May 8, 1871, made the level 700·4 feet, only a few inches lower than our measurement. Loch Ruthven is on the whole very shallow, having a mean depth of only 11 feet. The small eastern expansion has a flattish sandy bottom, with a greatest depth of 8 feet.

The narrow part, a mile in length, has a uniform central depth of 14 feet throughout, but in it, just three-quarters of a mile from the upper end of the loch, is an abrupt little hole of very limited extent, where the maximum depth of 42 feet occurs. The western basin has a flattish bottom, with a depth of about 13 feet, and two little depressions of 20 and 25 feet. Rock is exposed on the north shore at the bases of the Torrs, and at several points on the south shore. Though the rock is near all along the south shore, the beach is for the most part of gravel and boulders. The river flows out through a grassy flat.

The temperature on April 27, 1903, was 45·0° Fahr. from top to bottom, and the air at the time was also 45·0°.

Loch Ashie.—Loch Ashie is used for the water-supply for the town of Inverness. It is about 6 miles south of the town, and $1\frac{1}{2}$ miles east of Dores, on Loch Ness. It is an elongate loch of moderate size, having the same general direction as the Great Glen. The west shore is bordered for its whole length by Drumashie wood; on the east is a bare woodland stretch little higher than the loch.

Loch Ashie is $1\frac{2}{3}$ miles in length. It is nearly half a mile broad in the middle, and narrows towards each end. The mean breadth is one-third of a mile. Its superficial area is half a square mile, and the volume of its water 309 millions of cubic feet. It has a drainage area of nearly 3 square miles. Only a few very small burns go into it, and the Allt Mor, its natural outflow at the north end, flows into the river Ness two miles above the town of Inverness.

Loch Ashie forms a simple basin, with all the contours following the line of the shore, and the sides everywhere with a uniform gentle slope. The maximum depth of 51 feet is in the centre of the loch. The mean depth is 21 feet.

The surface on April 14, 1903, was 717·75 feet above sea-level, the water just lipping the sill of the sluice at the north end; the Ordnance Survey, on April 6, 1871, found the level to be 716·0 feet above the sea. On the date of the survey the temperature from surface to bottom was 41·8° Fahr., the air temperature at the same time being 36·0°.

In the thirty-three lochs of the Ness basin about 4400 soundings were taken, and the aggregate area of the water-surface is $34\frac{1}{4}$ square miles, so that the average number of soundings per square mile of surface is 128. The aggregate volume of water contained in the lochs is estimated at 280,923 millions of cubic feet, or less than 2 cubic miles. The area drained by these lochs is about 690 square miles, or twenty times the area of the lochs.

Appendices

I.

NOTES ON THE TEMPERATURE OF THE WATER[1] IN LOCH NESS.

By E. M. Wedderburn, W.S., LL.B.

Regular temperature observations in Loch Ness were begun at Fort Augustus in July 1903, at the same time as the first limnograph to be used in Scotland was erected. At first the temperature observations were subsidiary to the other observations made in the loch, but gradually their importance increased until the investigation of lake-temperatures became one of the principal studies of members of the Lake Survey stationed on Loch Ness. The observations were originally made from a rowing-boat by means of the Pullar and Lucas sounding-machines and deep-sea reversing thermometers. An endeavour was made to take the observations at regular hours in as nearly as possible the same positions in the loch from day to day, but in stormy weather the keeping of the same position during lengthy observations was attended with considerable difficulty. In September, however, a small decked fishing-boat, called the *Rhoda*, was anchored off Fort Augustus in about 300 feet of water. The anchoring of this boat caused some anxiety, but it was ultimately accomplished by means of a large mushroom anchor, which, with the necessary length of chain, was put at the disposal of Sir John Murray through the courtesy of Mr. Davidson, superintendent of the Caledonian Canal.

This boat was primarily intended to accommodate the electrical thermometers which were installed, but it came to be very largely used for taking observations by means of mercury thermometers. Lengthy series of observations could be taken in comfort whatever the state of the weather, and with great economy in time. It was possible to use three or four sounding-machines and thermometers at once, and consequently a series of observations could be made much more expeditiously than when only one sounding-machine was used.

The electrical thermometers were at first intended to furnish the means of observing continuously radiation into and from the loch. The apparatus was not altogether suitable for this purpose, and, being the first installation of its kind in this country, many unforeseen difficulties arose in the manipulation of the instruments, but nevertheless many valuable observations were made by its means. The installation consisted of three platinum resistance thermometers and a Callendar recorder. The boat-house of St. Benedict's Abbey was made available to the Lake Survey by the Lord Abbot of the monastery, and in it were placed the recording instruments. A four-ply cable connected the recorder with the *Rhoda*, which was anchored at a distance of about 300 yards from the boat-house. Many of the difficulties which were experienced arose from this cable; the strain of the wind and the waves was constantly damaging it, and as the *Rhoda* swung round with the wind great care was necessary to prevent the cable fouling with the anchor chain. On the *Rhoda* there were three large drums, on which were

[1] The water of Loch Ness was submitted to analysis by Dr. Tetlow, who found nothing abnormal about the water, except its softness and freedom from mineral matter, the total solids being equal to only 2·9224 parts per 100,000 (1·9012 parts of fixed solids, and 1·0212 parts of volatile solids); the principal constituents are sodium and calcium chlorides, while magnesium chloride, iron, potassium, silicon, carbonic acid, and sulphuric acid are present in traces.

wound the leads for the resistance thermometers. By these drums a thermometer could be lowered to any desired depth, and then connected to the shore-cable by means of mercury cup connections, and a continuous record of the temperature at that depth could thus be obtained. It was intended to lower each of the three thermometers to a different depth and connect them successively with the recorder, and so to get a series of readings at these depths, but the sluggishness of the recorder made this method of observation undesirable.

Temperature observations were taken at various points along Loch Ness. At times members of the survey were stationed at Invermoriston, Foyers, Inverfarigaig, Whitefield, and Dores. At other times a steam-launch was chartered and cruises made up and down the loch, taking observations *en route*, but this method of observation was very slow. The speed of the launch was about 6 miles an hour, and, as the loch is 24 miles in length, about eight hours were spent in steaming alone; assuming that six series of observations were taken, each lasting over half an hour, the observations at one end of the loch were taken six or seven hours later than at the other end. It was found that in this time the distribution of temperature in the loch might alter very greatly, and therefore observations made in this manner might give a very erroneous idea of that distribution.

The observations in Loch Ness were discontinued by members of the Lake Survey in September 1904, but the work was taken over by the monks at Fort Augustus (in particular by Father Cyril von Dieckhoff and Father Odo Blundell), and continued by them until April 1905, so that the observations extend over a period of nearly two years. The actual number of observations made in that time was about 12,000, and these have been discussed by the writer in papers communicated to the Royal Society of Edinburgh.[1] The results arrived at are briefly as follows:—

The yearly cycle of changes in a loch such as Loch Ness is very much the same from year to year. In September there is the greatest quantity of heat in the loch. Thereafter the loch cools gradually till March or April, when the water again begins to gain heat. This is the time when the mean air-temperature begins to be higher than the surface temperature. From May till August the increase in temperature at various depths proceeds regularly, and the typical curves representing the temperature of the water to a depth of 200 feet are practically straight lines. Below that depth it is probable that the temperature increases less rapidly in proportion to the depth, but even in the deepest waters of Loch Ness there is a range of temperature of about 2° Fahr. The lowest recorded temperatures in the deepest parts of the loch are in April, and the highest in the middle of November. During the period in which the loch gains heat, the most remarkable changes are those taking place at and near the surface. Rapid changes are of frequent occurrence, and are probably due to convection currents. On one occasion the temperature at the point of observation rose 6° Fahr. in two minutes.

When the mean air-temperature falls below the surface temperature, which is usually in August, the loch begins to part with its heat. This is shown in the change of type in the typical curve for September. The surface layers lose heat, while lower down the water still continues to rise in temperature; as already

1 "The Temperature of the Fresh-water Lochs of Scotland, with special reference to Loch Ness, with an appendix containing observations made in Loch Ness by members of the Scottish Lake Survey," *Trans. Roy. Soc. Edin.*, vol. xlv. p. 407 (1907); "An Experimental Investigation of the Temperature Changes occurring in Fresh-water Lochs," *Proc. Roy. Soc. Edin.*, vol. xxvii. p. 2 (1907).

mentioned, the highest temperature at 700 feet was observed in November, or about three months after the loch began to lose heat. In August the discontinuity between the upper and lower layers of the loch usually becomes well marked. As the upper layers of water become colder, there is a layer at the surface of nearly uniform temperature, and of gradually increasing depth. Below this layer there is a sudden change of temperature—a discontinuity-layer—below which there is the colder water in the loch. As the season advances this discontinuity-layer gradually sinks lower, and the layer of uniform temperature above it increases in depth, until finally the whole loch is of nearly uniform temperature.

Before the discontinuity-layer makes its appearance, the currents produced by winds are distributed through the whole loch. There is the surface current directly produced by the wind, carrying the warm surface water along with it, and the return current, to take the place of the water blown along the loch, is spread throughout the whole depth of the loch. But when the discontinuity-layer has formed, the loch is divided into two current systems. Above the discontinuity-layer there is the surface current produced by the wind, and the return current also takes place above the discontinuity-layer, without directly affecting the deeper waters. This return current, however, acts on the water below the discontinuity-layer just as the current of wind acts on the natural surface of the loch, and a secondary current is produced at the surface of discontinuity. This secondary surface current is much slower than the surface current produced by the winds, but to take the place of the water carried along by it, there is a secondary return current at the bottom of the lake. The secondary return current is very slow, and its existence was first suggested to the writer by experiments carried out in a glass trough, but observations support the view taken.

Another effect of the separation of the loch into two compartments by the surface of discontinuity, is to render possible the temperature seiche. The surface current produced by the wind transfers a large quantity of warm water to the lee end of the loch, with the result that the surface of discontinuity is deeper at the lee than at the windward end of the loch. When the wind moderates or ceases a temperature seiche is started, just as the seiche is started in a basin of water which has been tilted. The temperature seiche was also studied experimentally, and was made visible by superimposing a layer of paraffin on a layer of water. By driving the paraffin to one end of the trough by a current of air, the water, corresponding to the water below the surface of discontinuity in a loch, received a tilt, and when the current of air was stopped, a seiche started in the lower layer of water independently of the upper layer of paraffin.

The temperature seiche was first described by Mr. E. R. Watson in the autumn of 1903, and a good deal of doubt was expressed as to the accuracy of his views, but the theory of a temperature seiche was established by the observations taken in 1904. For a considerable period observations were taken at Fort Augustus every two hours, so as to obtain a continuous record of temperature. Observations taken in July and August 1904 show that in July changes at the surface, which are chiefly produced by winds, are accompanied by similar changes at all depths, but that in August, when the discontinuity-layer has been formed, the temperature variations at the surface are independent of the variations at a depth of 100 feet, where the variations are principally due to the temperature seiche.

Observations made at the two ends of the loch further support the theory, as showing that the layer of discontinuity was in general rising at one end when it was falling at the other end. Continuous records obtained from the Callendar recorder are also easily explained by the temperature seiche. Rough calculations were made of what should be the period of this seiche, based on the

assumption that the loch contained two layers of waters of different but uniform density. The observed period varied with the time of year, according to the depth of the discontinuity-layer, and was from two to three days, which agrees remarkably with the periods obtained by calculation.

II.

NOTES ON THE SEICHES OF LOCH NESS.

By E. M. Wedderburn, W.S., LL.B.

In June 1903 observations on seiches were begun in Loch Ness by the erection of a Sarasin limnograph in the boat-house of St. Benedict's Abbey, Fort Augustus. This instrument worked well during the period it was in use, and some good records of seiches were obtained. The largest seiche recorded by it occurred on November 21, 1903, and had an amplitude of about 4½ inches, but after about two days it was disturbed by the starting of another seiche.

In the summer of the succeeding year a second Sarasin limnograph was erected at Inverfarigaig, but it did not work satisfactorily—perhaps owing to the exposed situation—and the records obtained were consequently not looked upon as being entirely trustworthy, although, as was to be expected, they pointed to a node in the neighbourhood of Inverfarigaig.

Observations were also made by means of Forel's plemyrameter, but owing to the exposed character of the shore all along Loch Ness, observation by this means was very difficult. It is unfortunate that the index limnograph subsequently used by Prof. Chrystal had not been designed while work was being carried on in Loch Ness.

The observed periods of the uninodal and binodal seiches in Loch Ness are approximately 31·5 and 15·3 minutes respectively. Loch Ness thus belongs to that class of basins, in which the period of the binodal seiche is less than half the period of the uninodal seiche. The periods for Loch Ness have not been calculated according to Chrystal's theory—an exceedingly laborious piece of work, which it is hoped will yet be undertaken—but the writer has every reason to believe that calculation would agree with observation in this case also. For the basin of Loch Ness is convex at Foyers, where the floor of the loch rises some 200 feet, and, moreover, the sudden shallowing which takes place in the loch from Dores to Bona has the effect of increasing the ratio between the periods of the uninodal and binodal seiches. This is seen in the Lake of Geneva, where there is also a shallowing at one end of the lake, and where the period of the uninodal seiche is more than double the period of the binodal seiche.

Seiches of shorter periods were also of frequent occurrence, notably a seiche with a period of about 8·8 minutes, of which some remarkably pure records were obtained, although they were of small amplitude.

Embroideries on the curves were common, and were attributed to a long swell on the loch, to the wash of steamers, and frequently to the opening of lock-gates on the canal at Fort Augustus.

With the view of gaining information on the effect of small variations in atmospheric pressure, a Dines's sensitive barograph was obtained.[1] Records from an ordinary Richard barograph had indicated sudden barometric changes as a frequent cause of seiches, and the records of the sensitive barograph supported this view to a certain extent, although on some occasions the loch seemed unresponsive to

[1] The purchase of this instrument was facilitated by a grant from the Moray Bequest to the University of Edinburgh.

changes in atmospheric pressure. On other occasions, however, the limnograph record seemed to be an accurate reproduction of the record obtained by means of the sensitive biograph.

Loch Ness from its size proved to be rather unwieldy from the point of view of seiches, so that when, in the summer of 1905, the investigation of seiches was undertaken by Prof. Chrystal, he made his headquarters on Loch Earn, and gathered much information as to the cause of seiches from his observations.[1]

III.

NOTES ON THE DEPOSITS OF LOCH NESS.

By G. W. Lee, D.Sc., and L. W. Collet, D.Sc.

About sixty samples of the deposits covering the floor of Loch Ness were collected by the members of the Lake Survey staff from various parts of the loch, and were examined according to the methods used in the *Challenger* Office for the study of marine deposits.

They may be classed as follows :—

(1) *Dark grey mud*, from the deep basin opposite Urquhart bay.

(2) *Ferruginous mud*, from the part of the Invermoriston deep basin opposite Horseshoe craig.

(3) *Peaty mud*, from the south-west end of the Invermoriston deep basin ;

(4) *Yellow-grey clay*, from off Inverfarigaig and off Cherry island ; and

(5) *Brown sand*, from shallow water of Urquhart bay.

Samples of all of these were analysed by A. Wilson, F.I.C., and the following conclusions represent the result of the analyses :—

Loch Ness includes two deep basins separated by a barrier formed by the delta of the Foyers river. The muds from the south-western or Invermoriston basin contain a large amount of vegetable or peaty matter, brought down the lake probably by the rivers Tarff and Oich, with mineral particles coming from the disintegration of the rocks, transported by the streams. Small concretions of peroxide of iron and dioxide of manganese were dredged at one station. The muds often gave the characteristic reaction of manganese. On the slopes the muds are sandy, and of a red-brown colour, due to the presence of oxide of iron.

The muds from the north-eastern or Urquhart basin contain far less vegetable matter than those from the south-western basin, which may be due to the Foyers barrier retaining the vegetable matter in the upper basin. In the north eastern basin the vegetable matter increases with the depth, which is contrary to what is observed in the south-western basin. Off Urquhart bay the contour-lines approach each other very closely, and the vegetable matter brought down the lake by the river Enrick is carried towards the deeper part of the basin. Great differences are observed in the muds from the slopes on the two sides of the loch. On the north-western slope we find especially a red sandy mud, coming without doubt

[1] For further details the reader is referred to the following papers:—"On the Hydrodynamical Theory of Seiches, with a Bibliographical Sketch," by Prof. Chrystal, *Trans. Roy. Soc. Edin.*, vol. xli. p. 599 (1905); "Calculation of the Periods and Nodes of Lochs Earn and Treig, from the Bathymetric Data of the Scottish Lake Survey," by Prof. Chrystal and E. M. Wedderburn, *Trans. Roy. Soc. Edin.*, vol. xli. p. 823 (1905); "An Investigation of the Seiches of Loch Earn by the Scottish Lake Survey": Part I. "Limnographic Instruments and Methods of Observation," by Prof. G. Chrystal; Part II. "Preliminary Limnographic Observations on Loch Earn," by James Murray, *Trans. Roy. Soc. Edin.*, vol. xlv. p. 361 (1906).

from the washing out of the shore, composed of Old Red Sandstone. On the south-eastern slope we have a fine yellow clay, with fragments of rocks and large mineral particles without vegetable matter. The deposition of the clay in this position may be due partly to the strong prevailing westerly winds of Loch Ness giving rise to waves and currents, which would carry the fine clayey matter brought down by the Inverfarigaig river towards the south-eastern shore. Three stones from a depth of 100 feet, opposite Inverfarigaig pier, were covered with a dark ring of manganese dioxide, marking out the line between the mud and water, as was pointed out by Sir John Murray and Mr. Robert Irvine in their valuable paper, "On Manganese Oxides and Manganese Nodules in Marine Deposits."[1]

IV.

MIRAGES ON LOCH NESS.

A kind of mirage is one of the most familiar phenomena on Loch Ness, especially in winter and spring. It is best seen in the morning. Distant objects, such as the steamers plying on the lake, appear as though raised above the surface and floating in the air.

The most constant feature of the Loch Ness mirages is seen at promontories some miles distant. The shore-line at the promontories, though really nearly parallel with the horizon, is caused by the mirage to appear to form an angle with the horizon. When this angle is great (say 60° or more), the promontories appear like overhanging cliffs. When the angle is very acute, they seem to be suspended over the horizon. Objects which are known to be below the horizon are brought into view. The receding steamer, after sailing out of sight, will re-appear miles further away, raised high above the loch and looking very large. The promontory at Dores appears as a conspicuous island in the middle of the loch. The fathers in the Benedictine Monastery at Fort Augustus tell that on one occasion a snow-covered mountain appeared over the end of the loch. These phenomena are best marked at a distance of several miles from the observer. The steamer, sailing away from the observer, seemed, at a distance of a mile or more, to leave the surface of the loch and sail up into the air.

Signs of the mirage were sometimes to be distinguished at lesser distances. Standing on the deck of the Lake Survey yacht *Rhoda*, when the eyes would be 7 or 8 feet above the water, there could often be seen on the rocks of the nearest parts of the shore a conspicuous horizontal line, looking just like a high-water mark. In the reports of the Balatonsee Commission (*cf.* this *Magazine*, xxiii. p. 157), mirages of a similar nature are discussed. Von Cholnoky explains how they arise through the formation of lower stratum of warmer air, heated from the lake. In shallow lakes like Lake Balaton, the mirage is essentially a summer phenomenon. The lake remains warm during the night when the air cools.

In Loch Ness the converse is the case. The great body of water maintains a moderate temperature throughout the year. In summer the lake rarely attains to 60·0° Fahr., and so the air may frequently remain as warm as the lake, though mirages may occur after any cold night. In winter the lake maintains a high temperature, rarely falling below 42·0° or 43·0° Fahr., and thus the air will fall to a much lower temperature almost every night, and a well-marked layer of warmer air be formed by morning over the surface of the lake, giving rise to the mirage.

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[1] *Trans. Roy. Soc. Edin.*, vol. xxxvii. p. 721 (1894).

V.

"STORM-WEATHER" AT FORT AUGUSTUS.

Notes communicated by Dom Cyril von Dieckhoff.

The general features of well-developed "storm-weather" are low barometer, dry haze, wind usually south-east, blowing in isolated gusts ("isolated" with regard to space and time), low strata of cloud forming along lines parallel to the Great Glen, small cumuli forming rapidly in the air and drifting towards the north-west, where they mass and form large strata, often of very dark and threatening appearance. Little or no rain falls during the perfect type, but rain often comes when it breaks up. These small cumuli are well known as indications of gales from the south-east, and are called by the local sailors "Pack-merchants" (*i.e.* pedlars). There are various sub-species of this kind of weather, especially one where the wind is constantly shifting in every direction, the clouds all the while coming from the south-east.

In another type there is a north-east wind (warmer than the ordinary north-east wind), while the clouds come from the south-east. On these occasions the height of the lowest cloud is never much above 3000 feet. There are often several layers at different heights, all in a north-east to south-west direction—even alto-stratus pieces lie occasionally in this direction; their motion is usually very slow; cirrus comes slowly from the south-west.

"Storm-weather" may occur at any time of the year. The strongest gales, or at least the fiercest gusts, which we get on the loch, come from the south-east. On very rare occasions there has been noticed a kind of reverse to the "storm-sky" during a north-west wind.

VI.

NOTES ON THE GEOLOGY OF THE NORTH-EAST PART OF THE NESS BASIN.

By B. N. Peach, LL.D., F.R.S., and John Horne, LL.D., F.R.S.

Only a small portion of the Ness area has been mapped by the Geological Survey. It is situated in the north-east part of the basin, and includes the tract at the mouth of Loch Ness and on either side of the river issuing from that loch. It comprises a small part of Loch Ness, Loch Dochfour, Loch Ashie, Loch Abban, and Loch Laide.

The geological structure of the northern part of the Ness basin is well defined. The basin is traversed by the great fault that runs along Loch Ness, which is continued north-eastwards to Tarbat Ness, thus giving rise to the prominent cliff bounding the Moray Firth in the Black Isle. This powerful dislocation, which has been a line of weakness in the Earth's crust at successive geological periods and is evidently related to the earthquake movements that periodically affect the Inverness district at the present time, has a marked downthrow to the south-east. The exact position of the line of fault in the Ness valley is concealed by superficial deposits, but its course probably extends from near the western shore of Loch Ness at Lochend, north-east by Loch Dochfour, Dunean cottage, and Kinmylies, to the Beauly Firth east of Kessock ferry.

The effect of this great dislocation in the Ness valley is to let down the Old Red Sandstone strata on the south-east side against the crystalline schists and gneisses of Dochfour hill, the Abriachan granite, and the basal conglomerates and

sandstones of Dunean hill and Craig Leach on the north-west. The schistose rocks of Dochfour hill, which are pierced by the Abriachan granite, consist of quartz-biotite-granulites and felspathic gneisses, traversed by numerous veins of pegmatite. Occasional lenticles of garnetiferous hornblende-schist are associated with the gneisses, and a band of limestone also occurs in the schistose series at Blairnahenachrie, west-north-west of Dochgarroch. From their lithological characters, these crystalline schists have been referred to the Moine Series of the Geological Survey, the members of which are regarded as altered representatives of sedimentary deposits.

The triangular area of Old Red Sandstone on the west side of the valley of the Ness, extending from Dochgarroch north-east to Clachnaharry, and west to the Bunchrew burn, consists of coarse conglomerates and grits that dip to the north-west, and are overlain by sandstones, flags, and shales. Along their western margin they are bounded by a fault, with a downthrow to the east, which is probably a branch of the great dislocation running along Loch Ness.

On both sides of the valley of the Ness there is abundant evidence of intense glaciation of the region. On the elevated plateau west of the Ness valley the direction of the ice-movement varied from 25° to 35° north of east. The ice that issued from the Great Glen flowed more or less parallel to the long axis of Loch Ness, that is, in a north-easterly direction, but the trend became more easterly as it approached the basin of the Moray Firth. There is a wide-spread covering of boulder clay, with scattered groups of moraines, along the ridge extending from Dores north-east by Culloden moor. There is also a remarkable development of fluvio-glacial gravels, high river terraces, and remains of raised beaches at the mouth of Loch Ness, on both sides of the valley of the Ness, and on the south shore of the Beauly Firth.

Loch Ashie is a shallow lake surrounded by drift, with a fine series of moraines on its eastern side. Loch Laide also occupies a hollow in the drift, with small exposures of crystalline schists in places near its margin. Loch Abban lies in a hollow in the stratified deposits at the mouth of Loch Ness, which may be of fluviatile origin.

VII.

NOTES ON THE BIOLOGY OF THE LOCHS OF THE NESS BASIN.

By James Murray.

Collections of plankton were made in twenty-seven lochs in this basin. With the exception of the lochs in the Great Glen itself, most of these lochs are at a considerable elevation, occupying the high tableland on the east of Loch Ness, or the higher mountainous tract on the west.

The situation of the lochs in two alpine masses, separated by the deep cleft of the Great Glen, gives rise to some peculiarities in distribution, most marked in the species of *Diaptomus* and the more conspicuous plankton desmids.

A number of species were only collected on one side of the Great Glen. These peculiarities are probably due to the fact that the lochs to the east of Loch Ness were surveyed in spring or early summer, when the water was still cold, while those to the west were surveyed after midsummer, when they were about at the maximum temperature.

Diaptomus gracilis was here, as elsewhere, almost universal, but was not seen in several of the eastern lochs.

D. laticeps was in Loch Ness and the other lochs in the Great Glen. It was not seen in any loch to the west, but was frequent in lochs to the east of Loch Ness. In Loch Ness the blue *Diaptomus* (identified by Mr. Scourfield as *D. laticeps*) is somewhat small and pale in colour. In other districts, and especially in hill lochs, it is of larger size and brighter colours—blue or occasionally red. There is some doubt as to the identity in all cases, and naturalists have given different identifications of the Loch Ness animal.

D. laciniatus, in contrast to *D. laticeps*, was only found to the west of the glen, in lochs high above the sea. To the east, though it was not in any of the lochs surveyed, it was in some lochans at a great elevation on Carnahoulin.

Desmids.—The conspicuous plankton desmids, which constitute probably the most distinctive feature of the western Scottish plankton, are not very well represented in the lochs of the Ness basin. There are few species, but they include several of the largest and most beautiful. They show no marked preference for the one side of the glen more than the other, but the greatest number of species is in Loch Aslaich, which lies west of Loch Ness.

Micrasterias apiculata, var. *fimbriata*, was in Loch Aslaich, and the var. *brachyptera* was found only once in Loch Ness.

M. radiata, Hass (*M. furcata*).—This very local species was in Loch Aslaich.

Staurastrum furcigerum, Bréb.—In Loch Bran, at Foyers.

S. longispinum (Bail.).—In Loch Aslaich and several neighbouring lochs.

S. ophiura, Lund.—Loch Ness and Loch Aslaich.

S. sexangulare (Bulu.).—Loch Garth, near Foyers.

S. brasiliense, Nordst.—Loch Aslaich.

Euastrum verrucosum, Ehr., *Micrasterias papillifera*, Bréb., *Xanthidium antilopeum* (Bréb.), *Staurastrum gracile*, Rolfs, *Staurastrum lunatum*, var. *planctonicum*, West, and one of the beaked *Closteria*, which I identify as *C. setaceum*, Ehr., are the most generally distributed desmids in the basin.

Crustacea.—Apart from the Calanidæ, a few of the Crustacea appear to be local in the district.

Sida crystallina.—Only seen in Loch Ness and Loch Aslaich.

Diaphanosoma brachyurum.—Only noted in the lochs of the Great Glen and some lochs to the west. The eastern lochs were doubtless surveyed before its season.

Holopedium gibberum.—Noted in scarcely half the lochs, but those on both sides of the glen and at all elevations.

Leptodora was only seen in the lochs of the Glen and Loch Tarff; *Polyphemus* in the Glen and some lochs to the west; *Bythotrephes* in the Glen and Lochs Tarff and Ruthven to the east.

Rotifera.—*Conochilus unicornis* was generally distributed; *C. volvox* only in Lochs Ness, Laide, and Knockie.

Floscularia pelagica.—Lochs Ness, Oich, and Uanagan.

Synchæta pectinata.—Lochs Oich and Uanagan.

Anopus testudo.—Lochs Ness and Uanagan.

Triarthra longiseta.—In five lochs on the east side of the basin; apparently a cold-water species.

Gastropus stylifer.—Loch Ness and five lochs to the east, and Loch Aslaich to the west.

Sarcodina.—*Clathrulina* was not seen except in the lochs of the Great Glen. *Nebela bicornis*, West, though found in Loch Ness, was not got in the plankton, but while dredging in the shallow water of Inchnacardoch bay.

Loch Ness.—Loch Ness was made the subject of a more thorough, though still far from exhaustive, biological investigation than any other Scottish loch. A very large proportion of all the lacustrine organisms known in Scotland have been found in this loch.

The great majority of the species in all the larger groups—Crustacea, Rotifera, Sarcodina—have been got in Loch Ness, the only large group not very fully represented being the desmids. Some of the small groups have hardly been studied, except in Loch Ness, and it is the only loch the abyssal fauna of which is fairly well known.

To give any detailed account of the hundreds of species found in the loch would traverse too much the same ground as the general report on the "Biology of the Scottish Lochs," now in preparation. There will therefore be given here simply an epitome of the biology, and a comparison with the other lochs in the Ness basin.

The Plankton.—The plankton is the average plankton of Scottish lakes, with a very small admixture of the more local species. It is very poor in species, and always very small in quantity. No approach to "flowering" of the water has been noted. The greatest quantity was collected in late autumn, 1903, during the night, when a considerable migration from the deeper water to the surface evidently took place, as the quantity collected during the preceding day was much less. The plankton varies little throughout the year, a fact probably correlated with the low annual range of temperature, which is less than 20·0° Fahr., while the upper limit of about 60·0° is rarely touched.

About half the species of Crustacea remain all the year round, those which are absent in winter being *Bythotrephes*, *Polyphemus*, *Leptodora*, and *Diaphanosoma*. *Holopedium* was noted by Mr. Scourfield, but was never found during the systematic investigation afterwards. *Diaptomus laticeps*, Sars., appears to persist all the year round, and was found carrying eggs in March, when the temperature is at its lowest. *Clathrulina* was generally present, and *Volvox* occasionally.

There is a great contrast between Loch Ness and Loch Lochy in the relative abundance of the phytoplankton. Loch Lochy is very rich, and Loch Ness very poor. The two lochs are only some ten miles apart, and are apparently under almost identical conditions. Loch Lochy, being in an almost uninhabited district, should be purer than Loch Ness, but a slight pollution is generally favourable to vegetable growth.

Littoral region.—Though there are only a few sheltered bays in Loch Ness, where littoral vegetation can establish itself, the microfauna and microflora found among the larger vegetation are very considerable, and constitute, indeed, the chief part of the species in the loch.

A great many of the animals extend downwards to a very considerable depth, and about forty species (exclusive of Rhizopods), including many Crustacea, Rotifers, Tardigrada, Worms, and the larvæ of many insects, have been collected as far down as 300 feet. Shells of all the Rhizopods extend to the greater depth, and many live at greater depths than 300 feet.

In Inchnacardoch bay Mr. Scourfield found *Ophryoxus gracilis* for the first time in Britain; and the rare *Ilyocryptus agilis*, previously known in several places in England, was got in the same locality.

Abyssal region.—In Loch Ness a large proportion of the littoral species extend to about 300 feet in depth, probably because of the very steeply sloping sides. Those species only are considered as truly abyssal which are generally distributed over the mud, into the deepest part of the loch. A small association of animals is found thus distributed, and the abyssal region, being defined as the bottom where

this association is found almost free of admixture, must be considered to begin at about 300 feet. Exclusive of Rhizopods, there are about a dozen animals constantly found in this region, comprising—1 Mollusc, *Pisidium pusillum*, Gmel.; 3 Crustacea, *Cyclops viridis*, Jurine, *Candona candida*, Müll., and *Cypria opthalmica*, Jurine; 3 worms, *Stylodrilus galretæ*, Vejd., *Monotus morgiensis*, Du Plessis, and an undetermined Oligochæte; 1 insect, *Chironomus* (larva); several Infusoria, parasites on the Molluscs and Crustacea.

Several other species occur casually at great depths, such as *Hydra*, *Limnæa*, *Lynceus affinis*, and *Proales daphnicola*.

A small char, *Salmo altinus*, was dredged at a depth of over 500 feet.

Larvæ of *Tanypus* and some other diptera are frequent, but less constant than *Chironomus*.

Rhizopods.—Dr. Penard has identified about forty species and varieties from depths of more than 300 feet. They thus constitute the greater part of the species in our abyssal region, but their presence there is of little special interest, and there are only some half a dozen species and varieties which are doubtfully supposed to be peculiar to deep lakes.

Summary of the Number of Species.

	Species.		Species.
Mollusca	5	Dinoflagellata	3
Hydrachnida	1	Phanerogamia	33
Tardigrada	22	Equisetaceæ	1
Insects	6	Lycopodiaceæ	1
Crustacea	55	Characeæ	2
Rotifera	151	Mosses	6
Gastrotricha	2	Hepatics	2
Worms	12	Florideæ	2
Cœlenterata	2	Chlorophyceæ	46
Infusoria	11	Myxophyceæ (Report in preparation)	...
Sarcodina	67		
Mastigophora	3	Bacillariaceæ	20

We have thus a total of 453 species recorded for Loch Ness, excluding all Vertebrata, blue-green Algæ, and some other groups on which no work has been done. The Hydrachnida, Insecta, Worms, Infusoria, Chlorophyceæ, and Diatoms, have all been insufficiently studied, and the lists could be easily increased.

VIII.

NOTES ON THE AQUATIC FLORA OF THE NESS AREA.

By George West.

From certain points of view, plants may increase in interest and value in ratio to their rarity; of equal worth philosophically are those plants that occur in great abundance. The former, being scattered as individuals, or as small associations over restricted areas, are possibly, at present, of but small import in the economy of nature. The commoner plants, however, by reason of their dominance and abundance, become important agents, not only as a plant-covering to the Earth, but also in the effect they produce in the physiography of a country: barren tracts become heath or forest by the extension of vegetation; lakes are converted into morasses, moors, or even into land suitable for agriculture by the accumulation of

plant-remains. Such natural operations tend to increase the wealth and social prosperity of man. As examples on the other hand, the sudden increase of a baneful fungus may bring ruin to thousands of agriculturists, and carry famine to the million; or morasses in hilly districts may slide into cultivated valleys, and completely overwhelm sites of human activity and wealth. These and many other phenomena are brought about by the predominance of certain classes of plants. How great, therefore, are the interests awakened upon the fields of practical thought and knowledge by the abundant and dominant plants in their never-ceasing antagonism with one another and with other forces of nature!

It is chiefly with some of the factors that control the dominant water-plants of higher organisation in the Ness area that the following remarks are concerned.

The two great factors that contribute towards the distribution of the plant-covering over the surface of the Earth, and through its waters, are food and climate. Notwithstanding the conditions for plant-life being so often remote from the ideal, yet the plastic power that plants possess of adapting themselves to the various combinations of edaphic and climatic conditions is so great that there are comparatively few spots in which some plant or other is not able to thrive and carry on its metabolic activities. With aquatic plants the influence of the substances, food or otherwise, held in solution in the water, is vastly greater than that of climate.

The edaphic conditions dominating the flora in the majority of the numerous lakes of the Ness area are indirectly influences of climate. Indeed, the rock-basins that contain the lakes are themselves chiefly the result of climatic effects, because they were scooped out during a former period of glaciation. The study of our lake flora brings us, therefore, to consider the cause of a glacial epoch, and is thus the usher to one of the most abstruse and sublime realms of thought that the human intellect has ever been able to grapple with, so complicated and interwoven are the modes of nature's working. But to our more mundane considerations.

The yellow-brown colour of the waters of our highland districts is a matter of common observation, and is due to the water-supply from the mountains percolating enormous quantities of peat before reaching the lakes. This, then, would appear to be an edaphic influence; and so it is, but the existing conditions—the presence of peat on the mountains—have been brought about by direct climatic influence. The climatic conditions that obtain in the exposed portions of the highlands are more favourable to the natural production of moorland than of forest. The two formations—moor and forest—are antagonistic to one another, the tendency being for the moorland to extend from the higher situations over the domain of the natural forest of the lower altitudes. The principal natural causes for this victory of moor over forest are—(1) wind, which is much less antagonistic to moor plants than to trees; (2) the peculiar acid humus that is formed abundantly from the remains of certain dominant moor plants, and which acts inimically towards trees.[1] These natural conditions have undoubtedly been unwittingly hastened during the past two thousand years by the destructive influence of man on forest.

It is the presence of the peat extract in the water that is the dominating factor governing the aquatic flora of the Ness area. Its presence excludes directly a number of aquatic or semi-aquatic plants that might otherwise thrive. It obliterates any calcium carbonate that might be present, and thus renders the

[1] Space does not permit an explanation here of the involved complications brought about by these factors.

water untenable to calciphilous plants. On the other hand, certain calcifugal plants, having become accustomed to tolerate the presence of humic acids, abound. I scarcely know that one should say the latter thrive the better through lack of competition with the former, because commonly it is not that competition for available space is so great, as that the local conditions favour the dominant production of an individual species.

The peat extract darkens the water, and this restricts the depth zone to which submersed aquatics will grow, because they are unable to carry on photosynthesis beyond a very limited depth, owing to want of light. Therefore the photic zone throughout which there exists sufficient light for the proper development of the higher plants does not extend to a greater depth than about 30 feet in the lochs of the Ness area, and is often very much less than that. The extreme depth to which such plants as *Nitella opaca* and *Fontinalis antipyretica* will flourish in these lakes may roughly be estimated by multiplying by four the greatest depth at which one can see the brown gravel at the bottom, when looking over the shaded side of a boat about midday in the summer, when the sun is shining brilliantly, with the water perfectly calm, and the boat still. Such a depth in Loch Ness is from 7 to 8 feet.

This multiplier, however, does not hold where the multiplicand is considerably greater. Thus at Loch Fiart, on Lismore, one may see the bottom at a depth of 25 feet under the above conditions, but plants do not thrive at a greater depth than 40 to 45 feet. Possibly this is because the less refrangible rays of the spectrum, which are most necessary to photosynthesis, become insufficient at greater depths; although the rays of shorter wave-length may penetrate to greater depths in sufficient quantity to fulfil the requirements of the metabolic activities that are dependent upon them. It must be borne in mind that the yellow-brown colour of the peaty lakes probably neutralises the photo-chemical action of the violet rays at no great depth. We know that Rhodophyceæ thrive in the sea at least to a depth of 250 feet, but in all probability their reddish colour accentuates the photo-chemical action of the very feeble yellow-green rays[1] that penetrate such a depth of water. In similar manner a photographic plate becomes more sensitive to certain rays when its film is stained with suitable colours. Thus a film stained with erythrosin becomes sensitive to green and yellow. Exact information on these points in various waters of Scotland is much needed.

By reason of the preserving action of humic acids, the organic remains about the shores of the lakes do not readily decay, but undergo a slow process of disintegration, and form a sort of liquid peat. Owing to this action, suitably situated shallow places about peaty lakes become reclaimed by the growth of land-winning plants quicker than in water that is free from humic acids.

The last glacial epoch, after destroying the vegetation of Scotland, immediately began the formation of more numerous lake-basins for the reception of a greater aquatic flora after its disappearance. Not only this, for we find other results of glaciation actually dominating the vegetation in certain of our lochs at the present moment. At Lochs Oich and Lochy, for example, the sides of the adjacent mountains are coated with glacial drift-gravel. This gravel is brought into the lakes by the numerous streams in great abundance, and deposited upon the shores. Under the erosive power of the waves, the constant movement of this

[1] The rays for maximum photosynthesis in the red seaweeds are the yellow-green; thes penetrate water sufficiently for photosynthesis to about five times the depth that red rays do.

gravel upon the littoral entirely prevents the growth of aquatic phanerogams over a considerable area of the margin of the lakes. Again, in many places a steep escarpment, due to glacial action, enters a lake immediately, so that water too deep for phanerogams occurs without any shore whatever; instance Loch Ness opposite Invermoriston, where a depth of 652 feet may be sounded at about 120 yards from the margin. Here we see the indirect effect of a past epoch upon the flora of existing lakes, the lakes themselves being the direct result of that period.

Climate also affects the local distribution of the plants in each loch more or less. The prevailing, and frequently strong, winds are westerly; consequently there is, upon the eastern shore of a lake, a very considerable and oft-recurring wave-action. Acting upon a rocky or stony shore, this erosive power entirely prevents the growth of the higher plants in the shallow water where its influence is felt. Unless sheltered by adjacent hills, all the lakes will be almost, or quite, devoid of vegetation on their eastern shore, whilst the western shore, and bays sheltered from the prevailing wind, will have an abundant vegetation. The algæ of the seashore may be cited as an example, on the other hand, that plants can develop, and luxuriantly too, on a rocky shore subjected to powerful erosion, but the case is here entirely different. The seeds of phanerogams, excepting the tropical Podostemaceæ, have no power to firmly attach themselves to rocks and stones, as have the spores of seaweeds. Still we do find, even in exposed parts of our lakes, fixed rocks often covered with mosses, hepatics, algæ, etc.

Wind is an important factor in dwarfing the semi-aquatic vegetation about the littoral region of the lakes; especially is this the case with those situated in the more elevated and exposed positions.

The sudden rise of water to any great or prolonged extent is inimical to the well-being of plants in the lochs, particularly so if the water is extremely peaty. This is very pronounced at Loch Mhor, where an ever-changing level—due to the rainfall on the one hand, and the water used by the British Aluminium Company at Foyers on the other hand—does not allow a flora to grow at all. Previously existing trees at the margin have been drowned by the raising of the water-level.

In these peaty lakes the aquatic plants are usually remarkably free of epiphytic organisms, and also of mud; neither do they bear that deposit of calcium carbonate so common to aquatic plants in lakes that are devoid of the peat extract Humic acids, and perhaps carbonic acid too, in the waters almost extinguish molluscan life. Consequently one does not find the aquatic vegetation destroyed by these creatures, as is commonly the case where certain of them, especially *Limnæa*, abound.

The great variation between the summer and winter temperature of the water of the higher mountain lochs doubtless affects the flora to a greater extent than in those of lower altitude. These hill lochs are often shallow, and the comparatively small body of water may become heated to 70° Fahr. in summer, and may be frequently covered with ice in winter and spring. The ice often remains upon such lochs until April. Before its final disappearance, large shoals of broken ice grind upon the shores with surprising power and noise, and would destroy any littoral vegetation within its influence. Considering that such floating ice shifts about the loch with every change of wind, it is scant wonder that one so often finds these hill lochs devoid of marginal vegetation. In the great body of water of the large and deep lochs of lower altitude the temperature is more equable, winter and summer records not varying more than 10° to 20° Fahr., and such lochs seldom freeze.

It has already been pointed out that these peaty waters contain little or no calcium bicarbonate. Consequently there is no incrustation of calcium carbonate upon the aquatic plants. A necessary corollary to such antecedents is that no lime deposit resulting from the metabolism of plants is being laid down in these peaty lochs, as is the case where the water is charged with calcium bicarbonate.

The mud occurring in the peaty lakes of the Ness area is seldom of the black evil-smelling kind, such as is commonly found in non-peaty lakes, *e.g.* Duddingston Loch, near Edinburgh. In the latter case the decomposition of organic matter takes place with far greater rapidity than in water charged with humic acids. After the first stages of rapid decomposition comes the formation, among other substances, of ammonia, carbon dioxide, and hydrogen sulphide. It is the last-mentioned that gives the mud such an offensive odour when disturbed. In the presence of humic acids this rapid putrefaction does not occur. Instead, the disintegration takes place slowly by a kind of carbonising process. At the bottom of Loch Ness vegetable remains first become brown, then black and brittle, gradually crumbling to powder, and apparently no obnoxious gas is generated. Putrefaction does not take place, but rather a kind of desiccation—if one may apply this term to a sub-aqueous process. Likewise the mud from the bottom of Loch Ness has not the slightest offensive odour, neither does it stain one's hands as the fetid kind does.

Many plants, e.g. *Phragmites communis*, *Sparganium ramosum*, *Alisma Plantago*, etc., always grow more luxuriantly when the mud is black and fetid; but other species, e.g. *Sphagnum*, various sp., *Isoëtes lacustris*, *Lobelia Dortmanna*, etc., are unable to endure that kind of mud, not directly because of its presence, but because other factors, *e.g.* difference in food-salts, are correlated with the presence of this or that kind of mud. A number of other plants are comparatively indifferent, e.g. *Castalia speciosa*, *Menyanthes trifoliata*, etc.

Again, the aquatic vegetation being restricted to the photic zone, the greater portion of the bottom of these deep lakes receives but a small supply of organic remains. The refuse-eating fauna existing at the bottom is consequently able to maintain an equilibrium between supply and demand, so that the lake-bottom consists largely of the non-fetid excrement of these creatures. In shallow, non-peaty lakes, whose floor is wholly carpeted with vegetation, *e.g.* Duddingston Loch, the supply of organic detritus is greatly in excess of any refuse-eating fauna that may exist, therefore fetid mud results from the process of unhindered decomposition.

From the foregoing statements it will be readily understood that the flora of the lakes in the Ness area is subjected to many varying conditions, and in order to maintain a proper tone of health a plant has of necessity to respond in suitable ways to all the varying external impressions. A plant is therefore in a constant and continual state of change, owing to the never-ceasing mechanical, physical, and chemical changes of its unstable environment. The plastic nature of many plants enables them to modify their organs in reciprocation to any fairly constant set of environmental conditions; and it is in this endeavour to accommodate themselves for the maintenance of healthy existence in inhospitable places, that certain deviations from the normal forms of more kindly environments are to be accounted for. That such forms should receive definite specific or varietal names is open to grave doubt. Physiologists and experimental botanists are becoming more and more sympathetic towards the simplicity of the astute George Bentham; and whilst recognising, as did Bentham, the numerous forms fixed and transient, such are regarded as unit forms of the phylogenesis, or of the retrogression of a species.

In many districts one may distinguish mountain lochs by the presence of

certain plants, as, for example, *Isoetes lacustris*, *Lobelia Dortmanna*, *Potamogeton polygonifolius*, *Sparganium natans*, *S. minimum*, etc., and by the absence of reeds at the margin. But in the Ness area the presence or absence of such plants and associations is certainly no criterion of the elevation of a loch. All the plants enumerated are to be found at so low a level as Loch Ness (52 feet above the sea); and a reedy margin is found at quite highland situations, whilst it is almost absent in such low-lying lochs as Oich and Ness. The reason for the presence or absence of certain plants is not one altogether of elevation, but is rather due to the supply of food-salts and the amount of exposure of the water to winds, coupled with the nature of the shore. The mountain lakes usually drain a very small area, poor in food-salts and rich in acid humus; consequently, only those plants are found in them that can obtain their requirements from an apparently scanty food-supply, combined with the presence of humic acids. Such plants are those that have been associated with mountain lakes. Lowland lakes usually drain a wider area, and soils poor in peat and rich in food-salts, which, although indispensable to most plants, are poison to others. In the area of Lochs Ness and Oich there is but a small amount of soil rich in food-salts available for drainage, compared with the soil poor in food-salts and rich in acid humus. Consequently, the effect of drainage from a small, rich food-area is almost extinguished by the humic acids, and in such lowland lochs we find vegetation identical with that of the highest mountain lakes.

Again, in Lochs Oich and Ness (and, of course, others) we have practically no reedy margin, neither have we in many mountain lakes. The reason for this is the nature of the shore, combined with the erosive power of the waves, leaving altogether out of the question food-supply. On the other hand, in mountain lakes with a sheltered peaty or muddy shore, as in lowland lakes of like nature, we find a reedy or sedgy margin. Highland lochs are usually in situations fully exposed to the fierce winds, their shores rocky or stony; consequently, they have few plants about their margins. Their water, being poor in food-salts and rich in humic acids, has a restricted aquatic flora; but the same conditions may obtain in the lowlands, when the flora of the lakes will be similar. On the other hand, a highland loch having a supply of food-salts, with a suitable shore and sheltered from prevailing winds, may quite well have the character of a lowland loch regarding its flora.[1]

FERDINAND VON RICHTHOFEN'S DIARIES FROM CHINA.[2]

THESE two volumes present a complete itinerary of the late Baron von Richthofen's travels in China. The journeys extended over a

[1] For further information on the lochs and their plants, see "A Comparative Study of the Dominant Phanerogamic and Higher Cryptogamic Flora of Aquatic Habit, in Three Lake Areas of Scotland" (with 110 illustrations), by George West, *Proc. Roy. Soc. Edin.*, vol. xxv. pp. 967-1023 (1905).

[2] Ferdinand von Richthofen's *Tagebücher aus China*, von E. Tiessen. Berlin, Dietrich Reimer (Ernst Vohsen), 1907. Selected and edited by E. Tiessen; in two volumes, with 14 photogravures, 13 of which are from original drawings by von Richthofen, with an accompanying general map of the provinces of China, showing the routes followed by von Richthofen.

period of four years, from September 1868 to October 1872, with the exception of nine months, August 1870 to May 1871, which were spent in Japan. It is quite characteristic of von Richthofen that the personal narrative and general observations entered in his diaries should have been regarded by himself as of comparatively little significance and interest, and their publication postponed until some convenient time after he should have completed an exhaustive treatment of the scientific and economic results. Among his papers, however, finished manuscripts were found relating the daily events of four of the seven journeys he made in China, and his former students were inspired with the wish to complete this popular work and publish it in honour of the "Richthofen Day" which is now an annual institution amongst them. Baroness von Richthofen gave her cordial consent and every help in her power, and Dr. Tiessen undertook the selection of the further extracts that should be necessary from the original diaries. This he has done so admirably that the work has all the effect of a connected, irresistibly-flowing narrative, fresh from the master's hand. The only interruption in the consecutive plan of the book as a diary is the interpolation of some of the letters written by von Richthofen to his parents in the course of his travels. But as the more important letters were written at the close of each long tour, they form a helpful summary of the foregoing chapters, and allow the reader a more intimate glance into the human longings and affections of the great geographer than von Richthofen would ever have permitted himself to convey to a notebook or a manuscript. They remind us that when von Richthofen began his investigations in China he had already been absent from home for eight and a half years, first as a member of Count Friedrich zu Eulenburg's expedition in Eastern Asia, then for six years working strenuously in geology and mineralogy in California.

The diary begins with von Richthofen's departure from San Francisco on 22nd August 1868, and his explanation that in view of the probable practical outcome of his investigations the Californian Bank had undertaken to defray the expenses of an expedition; at that time von Richthofen calculated on a year's work or rather more. The crossing to Japan, the encounter with a dangerous typhoon, the landing at Yokohama and Nagasaki, and the sail through the beautiful inland sea, are graphically set forth, and one is struck with the accuracy of the traveller's impressions of the Japanese people and his forecast of their rapid rise to a prominent position among the world's Powers.

Von Richthofen's first impressions of the coast of Shantung were very favourable, and at Chifu he was fortunate in meeting the Rev. A. Williamson, a missionary of wide travel and repute in north-eastern China. At Tientsin, von Richthofen, together with a few other Europeans, engaged small boats which were towed in train up the river to Tungchau. The four days picnicking on land and boat in the course of the slow progress and long pauses strike the only restful note in the two volumes. Jolting cars or ponies brought the passengers from Tungchau to Peking, which was reached on the 29th September. From the moment when he entered Peking, von Richthofen's mind moved endlessly, relent-

lessly upon the gigantic task he had undertaken, and not even the entire absence of egotism throughout the diaries can prevent the reader from realising that only a magnificent physique and an iron will as strong as that other will which in these same years was rearing a new Germany, could have borne the traveller through the unceasing toil, anxieties, dangers, and unspeakable discomforts of the years spent amidst a teeming and often hostile population. His only days of security and peace were those spent in remote recesses of the mountains, and even there he had always the pressing anxiety of the care of his baggage and his car-drivers or coolies as the case might be.

When at Peking, von Richthofen secured a pass from the Chinese Government which proved of the utmost value to him, as it ensured to him everywhere the protection of the mandarins. At the same time these officials were unable to stem the curiosity and sometimes the evil passions of the mobs of Chinamen that gathered round von Richthofen in the villages and towns. On a few occasions the mandarins sent a small guard of soldiery with him, to conduct him through the worst districts. But as a rule von Richthofen had to rely entirely upon his own resourcefulness in the face of the sudden dangers that sprang into existence as soon as a crowd formed. Stoning was the common sign of hostility, but in various ways von Richthofen succeeded marvellously in conciliating the inhabitants.

The diaries have quite a special value in the close acquaintance they display with the habits, character, and customs of Chinamen of all social grades and in the different provinces. The reader becomes quite familiar with all types, such as the Chinese innkeeper, the road-car hirer and baggage contractor, the miner, the field-worker, the boatman, the glass and pottery worker, the market bargainer, the coolie, and with the family life among the workpeople; on the other hand, the mandarin of the various ranks is met with from town to town, and there are visits to the small schools, with a dozen scholars all sighing for one of the visitor's cigars; to the University of Yo-lu, with hundreds of students and only one professor; to famous temples and their priests; also audiences with august personages of the highest rank.

Von Richthofen sailed from Peking to Shanghai, and in November 1868 made the first of his journeys in the neighbourhood of Ningpo. There he examined and mapped the red sandstone, quartz, porphyry, and tuffs, and made various tours eastward, among the Chusan islands. He thought the harbour of the largest Chusan island a position that could be made of high strategic and commercial importance in the hands of a European power. Returning to Ningpo on 1st December 1868, he followed the distribution of the same varieties of rock northward, and mapped on both sides of the Grand Canal as far as Chin-kiang. There his boat entered the Yangtsze-kiang river, and was towed up stream to Nanking. With the American Consul he secured an audience of the great *Lihungchang*, then Viceroy of Hupeh and Hunan, and *Ma*, the Viceroy of Kiangnan and Kiangsi. Von Richthofen wished to find out how far the viceroys were likely to favour the opening of new mines if he should discover good prospects in the

course of his investigations, or if they would support the better development of the mining industry in their provinces. At first the viceroys brought forward the Chinese superstition that mining disturbed the spirits of the living and of their ancestors, and was not to be encouraged or augmented, but when more closely pressed in the course of the long audience Li gave quite clear answer to the effect that the Chinese Government had their own necromancers, and would open and work mines for themselves, without assistance from foreigners. The interview was in so far of practical value to von Richthofen that he knew henceforth he had nothing further to expect in the way of support from the Chinese Government than the pass in his pocket. He returned to Shanghai, and made elaborate preparations for his second journey whose aim was the survey of the areas north and south of the Yangtsze-kiang river.

A house-boat was hired, and stores laid in for a six-weeks' tour; several boatmen, two boys, and a man in charge were engaged, and it was on this occasion that von Richthofen had the good fortune to find an excellent attendant, Paul Splingaert, a Belgian by birth, who had a very fair knowledge of spoken Chinese. Splingaert accompanied von Richthofen on all his subsequent journeys in China, was clever and tactful in dealing with the Chinamen, and met the constantly recurring difficulties with fearless spirit and loyal devotion to the aims and purposes of his master.

Von Richthofen's plan for this second journey was to go direct up stream to Hankau, and if possible penetrate farther to the coalfields of Honan, and the upper reaches of the Yangtsze-kiang, then to move slowly down stream, and make excursions on foot from places where the boat might with safety be anchored. At that time pirate boats were a pest to the traffic of the Yangtsze, and boats could only wait by day or night with safety in specially protected river harbours. At Hankau von Richthofen's plan was checkmated; the mining population up the river was said to be in a wrathful, excited state, owing to the visit of some English mining engineers, and there was not enough water in the side canals to allow the boat to reach the mines from which the best coal was reputed to come. Returning down stream, von Richthofen had a successful period of work among the hills on both sides of the valley from Hankau to Chin-kiang. Coal measures were examined in a number of localities, and in an excursion among the limestone hills on the south bank von Richthofen found among other fossils abundant specimens of Fusulina, belonging to the same species that characterises the carboniferous limestone of Russia.

The diaries, however, merely mention such geological features; they describe with much care and detail the natural produce of the ground, the Chinese modes of cultivation, the local industries—such as the making of paper, and the very complicated preparation of medicines —the internal import and export traffic between provinces. And they frequently lament the destruction of trees and herbage, and the absence of any attempt to make use of the hill ground as pastureland for cattle, also the rudimentary ideas of fruit culture. The beautiful sites

selected for the temples have alone been allowed to retain an ornamental dress of foliage, and to the large number of temples is chiefly owing the preservation of some natural forest scenery among the hills. The ascent of the Sacred Hill of Lu-shan, which bears the temple of Liaufongtsze, was a particularly lovely tour, but threatened to come to a violent close, as the villagers ran after von Richthofen and Splingaert in crowds, and threw stones. Similar experiences were met in the market-town of Tung-yang a few days later.

The granite hills lower down the river and their relations to the limestone were mapped, and von Richthofen's first observations made on the "Loess" clay, although it was not until a later journey that he formulated his famous "wind-theory," which explained its origin as blown dust and sand, intermingled with surface soil. The coal mines of Kautsze near Chin-kiang provided von Richthofen with rich fossil material that disproved Pumpelly's report of the Permian age of all the Chinese coal measures. As von Richthofen carefully entered in his diaries, the fossils he found showed that "at least in part the coal measures of China were identical in geological age with the coal formations of America and Europe" (i. p. 132).

Mission stations received a considerable share of von Richthofen's attention, and to his mind very few of these were conducted on satisfactory lines. He particularly objected to the practice in some missions of the European missionaries adopting Chinese dress and customs, and wished that the mission stations could have model farms attached to them, and the missionaries make some practical effort to instil more progressive methods of agriculture into the minds of the people (i. p. 177, ii. p. 74, etc.).

The third journey had Shantung for its object. Boat was taken from Shanghai by the Yangtsze-kiang river, and then northward by the Grand Canal as far as the point where the canal is crossed by the old course of the Hoang-ho river. Then came an arduous journey by road, and many difficulties of transit had to be overcome. The entry into Shantung province was marked by a distinct improvement in the condition and habits of the population. The coal mines of I-chau were examined, and a long traverse through the mountains brought von Richthofen to Tsi-nan on the northern slopes, the chief town of Shantung; from there the company travelled eastward along the skirt of the Shantung mountainland, but made excursions southward to visit the coal districts of Pu-tsuën, Poshan, and Wei-hien.

The whole conduct of this journey and the certainty with which von Richthofen laid hold of all important physical and economic features must arouse the highest admiration, yet the intellectual accomplishment of his task was not more marvellous than his manipulation of the Chinese mind and his methods of persuasion, diplomacy, and calm determination, which enabled him to bend others to his will. On all occasions he endeavoured to convey to the Chinaman that a European dealt with honour and justice, and repaid good service in full measure when it was rendered. The narrative of the seven weeks' journey, 13th March to 30th April 1869, is one of intense interest from beginning to

end. Although the country was not re-visited by von Richthofen, the accuracy and fulness of the notes and observations taken during this single traverse enabled him to prepare afterwards his classic works of scientific and popular character on the province of Shangtung. It was undoubtedly von Richthofen's pioneer tour in 1869 that proved the basis for the action of Germany when, in 1897, it seized the Bay of Kiao-chou, and secured a ninety-nine years' lease of that port and district from the Chinese Government. The railway now in existence, under German rights from Kiao-chou to the Wei-hien coal district, may be taken as the fulfilment in part of the scheme projected in von Richthofen's "Diaries" (i. p. 192).

From Shantung, von Richthofen crossed the Yellow Sea to Southern Manchuria, and spent a month in examining the Liau-tung Peninsula, and mapping the hill ridges. He continued northward along the Korean frontier, and felt the short intercourse with the more alert and cleanly Korean people a pleasant relief after his troublesome dealings with coolies and car-drivers. Mukden was reached after several zig-zag tours among the mountains, and the main road was followed from Mukden to Peking, although its condition, except in the immediate vicinity of Mukden and Peking, was little better than the bed of a rushing stream.

Again von Richthofen returned to Shanghai and set out on 24th September 1869 for his fourth tour. This was spent chiefly in the tea provinces of Kiangsi and Che-kiang, for the purpose of completing his map and observations on the district of Lake Po-yang and the Lu-shan range. The visit to King-te-chen, the centre of the porcelain industry, and to the Lo-ping coalfield, were the most notable features. In spite of frequent unpleasant encounters with excited crowds, his diary of the journey in this luxuriant part of the southern "garden of China" shows intense enjoyment and appreciation of the novel sights that opened out before him, and one detects also a fuller comprehension of Chinese life and limitations. The Diaries make perfectly clear that in no sense can the country be said to be over-peopled, for in spite of the swarming population in every town and village there are extensive tracts of ground, especially among the hills, still to be brought under cultivation. The richer people are essentially town-dwellers, and von Richthofen frequently remarks on the non-development amongst them of any love of natural scenery or interest in a country life.

On 1st January 1870, von Richthofen started on his remarkable traverse of China from Canton to Peking, which he completed on 30th May. He was enabled to undertake the heavy expenses of this and his later journeys by means of a grant from the Shanghai Chamber of Commerce, given on the understanding that he would prepare for them a report of his results. The report was duly written and printed in Shanghai under the title of *Letters on China* (1870-72), and it laid the foundations of all our present-day knowledge of the geography of China.

A full description of the Loess and its distribution is included in the diary of this fifth, and probably most important of his journeys in China. It was shortly after von Richthofen entered the southern part

of the province of Shansi that, guided by some leading fossils, he discovered one of the finest coalfields in the world, where the coal-bearing strata extend in little disturbed position over a wide stretch of country (i. p. 494). An amusing description is given by von Richthofen of the expedient he resorted to in the busy market-place of Ta-ying-kai in order to satisfy the curiosity of the mobs. With Splingaert and his other attendants he marched through the city and made a circuit through the main streets, while the people crowded in thousands, and shouted with joy and excitement to see the wonderful "foreign devils." Von Richthofen hoped then to be allowed peace in the inn, but soon two thousand and more collected in front of the inn, saying they had missed the sight on the street, and he had to make a second brief appearance to satisfy the late comers.

At the conclusion of this journey, von Richthofen experienced in Peking the political anxieties of the summer of 1870, when the massacre of the French residents at Tientsin shocked the civilised world. The unsettled state of the country decided von Richthofen to cross to Japan and set to work there. He was offered a high appointment in Japan as Chief of the Survey, but declined this, and returned to Shanghai in May 1871. In spite of the hot season he at once started on a walking tour in the mountains of Chekiang. Ten coolies were engaged as carriers, and his trials to keep them in motion were not few. Von Richthofen during this journey determined the essential continuity in structure of the mountains of Chekiang with those in Japan, and from this time onward his diaries show how, step by step, he followed each point of evidence, and arrived at his brilliant conception and elucidation of the structural relationships of the mountain-systems of Eastern Asia.

The Che-kiang tour reads like a tale of exciting adventure, interspersed with passages where the traveller refreshes his mind in the beauty of gorgeous summer vegetation and romantic hill scenery, or tells how the night's resting-place was the open court of a temple or some sheltered nook on the hillside. The daily routine, from the rising at 4 A.M. to the completion of his day's diary and entry of all notes as late as 11 or 12 at night, now and then appears from the narrative. Those who knew von Richthofen will marvel less at the regularity and system of his daily habits when they remember that to the last day of his life these were the hours unvaryingly adhered to in all his Alpine tours.

The last of von Richthofen's journeys in China had for its object the investigation of the western areas, where the chains of hills that branch eastward through China converge in a high group with a north-south direction. The western provinces of China are also those with the greatest wealth and variety of minerals, and von Richthofen was most anxious to secure a general survey of the district. Western China was, however, in a critical condition politically, and a rough soldiery under local governors had been raised to keep order, but were proving utterly inadequate to the task.

Von Richthofen set forth from Peking on 25th October 1871, and calculated that his journey as planned would occupy six months. As a

matter of fact he arrived on its completion at Shanghai, on the 21st May 1872, but he had been compelled by adverse circumstances to alter the latter part of his plan, and to return by the Yangtsze-kiang river without having surveyed the southmost provinces of Yünnan and Kwei-chau. He had succeeded, however, in obtaining a full and reliable series of observations in remote parts of Shansi, Shensi, and Se-chw-an, and in completing his general survey of China, with the exception of the south-west frontier country towards Burma. The adventures and mis-adventures in the last of his journeys were more serious in character than in any of the earlier tours, and the reader follows the tale of the diaries with suspense and keen sympathy for the great geographer in his almost superhuman efforts amidst an alien race, and feels thankful that he had with him his one faithful attendant Paul Splingaert.

The "Diaries" present a wonderful story of devotion to scientific purpose, and accomplishment of high ideals, wrung, as it were, against overwhelming odds. The work is undoubtedly destined to take its place among the prized classics of geographical science, and will help to impress upon eager students of geography and geology that success in outdoor research demands much more than a clear brain and certain powers of observation! The habits of stern discipline and indifference to personal comfort that we associate with a military training were inbred in von Richthofen, albeit his early training had entirely followed intellectual lines.

The two volumes are excellently printed, and are much enhanced by the illustrative plates. The attitudes of the Chinamen portrayed in one or two of von Richthofen's sketches are highly realistic, and a special interest attaches to the photogravures of some of the geological sections and actual pages from the traveller's note-books. The most suggestive, as showing von Richthofen's mastery of his subject, is the topographical sketch in the second volume, in illustration of part of his sixth journey, in Che-kiang.

MARIA M. OGILVIE GORDON.

GEOGRAPHICAL NOTES.

ASIA.

Russian Expedition to Kamtschatka.—According to a communication to the Press Association, a large and well-equipped expedition organised by M. T. P. Riabouchinsky at his own expense, with the active co-operation of the Russian Geographical Society, left St. Petersburg early in May for Kamtschatka. The expedition comprises five sections—viz., geographical, botanical, zoological, meteorological, and ethnographical. Each is complete in itself, with its own special programme. Some of the geologists will visit the whole eastern coast of Kamtschatka, from Petropavlovsk northwards to Baron Korfa Gulf, while others will make a detailed study of the central and unexplored volcanic region.

During the present summer the botanical section will cover the country between Petropavlovsk and Lake Kronotzkoe, while next summer it will work south of Petropavlovsk to Cape Lopatka.

The Kamtschatka river valley will be the principal sphere of activity of the zoological section, and three posts will be established for studying the fish of the salmon family which abound in the local rivers.

Three meteorological stations will be constructed at Tigil, Kintchevska village on the Kamtschatka river, and Petropavlovsk.

The ethnographical section will first visit the Aleutian and Behring Islands, and will not reach Kamtschatka until the autumn of 1909. One part of its work will be to discover traces of the oldest aborigines.

The expedition numbers in all twenty scientists, who will spend about eighteen months in Kamtschatka. At the instance of the Ministry of Marine a military transport has been placed at their disposal by the Vladivostock authorities. The Central Hydrographical Administration has supplied them with a quantity of scientific instruments and other valuable apparatus.

Polar.

Meteorology in the Antarctic.—Dr. W. S. Bruce has received some further information as regards the party which returned from the Meteorological Station at Scotia Bay, South Orkneys, during the present year (cf. this *Magazine*, p. 209). Mr. Rankin and his party arrived on board the *Uruguay* at Buenos Ayres on March 30, bringing with them a very valuable series of meteorological and magnetic observations. In addition the party seems to have carried out some interesting biological research. The ice in Scotia Bay did not break up till the third week in January. The *Uruguay* had a very rough passage home, taking eleven days to reach Port Cook, Staten Island, from the South Orkneys. We shall publish here shortly an account by Mr. Mossman of the chief results so far obtained at the Scotia Bay Station.

International Polar Congress.—In accordance with a resolution passed at the International Polar Congress held at Brussels in September 1906, the Belgian Government invited delegates to a meeting for the constitution of an International Polar Commission. The delegates assembled at Brussels on May 29, and the business came under three headings:—(1) The appointment of a Provisional Bureau of the International Polar Commission; (2) the discussion of modifications suggested in the proposed Statutes; (3) the reading of scientific communications.

Dr. John Rae and the Fate of Franklin.—The recent death of Sir Leopold McClintock (see this *Magazine*, December 1907) and the announcement that a memorial is to be erected in his honour in Westminster Abbey recall the circumstances of the discovery of the fate of Sir John Franklin and his expedition and the respective shares of Sir Leopold McClintock and Dr. John Rae in that work. That McClintock

discovered in 1859 the document recording Franklin's death in 1847, and that he confirmed the fate of the entire expedition of the *Erebus* and *Terror* should not be allowed to obscure the fact that the earliest news of the fate of the Franklin expedition was brought to light by Dr. John Rae in 1854, after almost five years of continual and systematic search on his part. Dr. Rae established beyond doubt that the Franklin expedition had met with disaster on the west coast of King William Land, and that thirty bodies had been found near the mouth of the Great Fish River, and he had no doubt that the relics he recovered from the Esquimaux were obtained from the last survivors of the expedition. McClintock's later success was in large measure due to his following up the line of route indicated by Rae, whose advice he took prior to the sailing of the *Fox*. The British Admiralty on the return of Dr. Rae with his information, considering that he had "set at rest the unfortunate fate of Sir John Franklin and his party" (to quote from the Arctic Blue-Book, 1855) ceased all further search, and awarded Dr. Rae the Government grant of £10,000 for the first authentic information—a reward of which Dr. Rae was in ignorance until the moment when it was granted to him. It is only right, after the passing away of both Rae and McLintock, that the respective parts played by each of these polar explorers should be made clear, and it would be an historical error, not to say an act of injustice, to overlook the claims to Rae to be considered as the earliest discoverer of the fate of the Franklin expedition.

It may be of interest to recall that certain of the Franklin relics brought back by Dr. Rae can always be seen in the Library Hall of the University of Edinburgh, of which university he was a graduate.

Prince Charles Foreland.—On the 13th of April Dr. William S. Bruce addressed the Royal Geographical Society, the subject being Explorations on Prince Charles Foreland. At a future date it is Dr. Bruce's intention to communicate a further paper to this *Magazine*, being a continuation of last year's report in the *Scottish Geographical Magazine*.

The British Antarctic Expedition.—Private correspondence from various members of the staff of this expedition give accounts of its progress up to the time when the *Nimrod* landed the wintering party (cf. p. 209). From these letters and other sources we extract the following notes in regard to the voyage of the *Nimrod* to the south.

On January 16 the ship experienced a heavy snowfall which decreased as the vessel continued further south, and entered a colder and drier region. The Great Ice Barrier was sighted on January 23, and its height at the point reached was found by measurement to be about 120 feet. Professor David gives a very eloquent description of the beauty of this gigantic wall of ice, with its bright blue crevasses. Some of the crevasses were of very remarkable shape, being narrow above and below but gaping widely in the middle, so that they had the appearance of biconvex lenses set on edge. These crevasses began at about 30 feet below the summit of the ice-wall, had a vertical height of about 15

to 20 feet, and thus died away at about 50 feet below the top of the Barrier. They seemed to intersect the edge of the Barrier obliquely. Thus, while the barrier edge ran nearly east and west at this point, these peculiar crevasses ran about WSW. and NNE..

The intention was to land at Balloon Inlet, the point where Captain Scott and Lieutenant Shackleton made a balloon ascent to a height of about 700 feet in 1901. While steaming towards this point on January 23, the party saw low rounded hills, covered with ice and snow, lying at a distance of about 10 to 12 miles from the barrier. The height was estimated at about 800 feet above sea-level, and the region was close to where Ross marks "appearance of land." The fact that this land was not seen by the party on the *Discovery* was no doubt due to the thick weather which prevailed when the ship was in this region. In this region the Barrier was fringed by bay ice, which was swarming with animal life—emperor penguins, Weddell seals, petrels, skuas, with fin-backed and killer whales in the open water were all seen. As the course was continued further east the pack was encountered, and the vessel had to be kept well out to avoid it. No signs of Balloon Inlet, which in 1901 ran nearly 10 miles to the southwards, could be seen, and careful observations showed that what had been the inlet was now represented by a large bay, at the head of which was a remarkable undulation of the Barrier bringing the snow surface down to sea-level. But this low spot was blocked by icebergs in front and was impracticable as a landing-place. A sounding was taken here and gave 300 fathoms, no bottom. Further investigation showed that the Barrier has receded 11 miles at the point where Balloon Inlet was formerly placed, owing doubtless to the breaking off of a great mass of ice here. An attempt was then made to make King Edward VII. Land, but it was soon found that the road was barred by impenetrable pack and floe ice. The *Nimrod* was then put about, and just succeeded in making her way back between the pack and the Barrier, with the ice threatening to close in on all sides and nip her. After reaching more open water, it was decided to make another attempt to reach King Edward VII. Land by trying to round the other side of the pack. A north-easterly course was set, but by January 25 the boat was once more stopped by impenetrable pack, and all hope of reaching this land had to be abandoned. At one time the ship was within some 40 miles of King Edward VII. Land, but between her and it stretched impenetrable pack. As there was no possibility of negotiating this, and no possible landing-place existed on the Barrier, it was reluctantly decided to run for M'Murdo Sound.

On January 28 the top of the cone of Mount Erebus was sighted, with its cloud of steam above. On the morning of January 29 Cape Bird, the north-west end of Ross Island, was passed, and the vessel headed south for the *Discovery's* old winter quarters in M'Murdo Sound. She was brought up just south of Cape Royds. On January 31, during the landing preparations, a sad crane accident occurred which injured Mr. Mackintosh, the second officer, depriving him of the use of one eye. The accident took place while a heavy package was being hoisted from the hold.

Flaxman Island, Alaska.—In *The Journal of Geology* (xvi. 1) Mr. Leffingwell, of the Anglo-American Polar Expedition (cf. this *Magazine*, vol. xxiii. p. 656), gives an interesting account of this island, which was the winter quarters of the expedition. The island lies off the northern shore of Alaska, being some two miles from the mainland. The nearest portion of the mainland consists of low tundra plain, stretching about twenty miles back to the mountains. A coastal plain of this tundra type is a characteristic feature of this part of Alaska, and in this region, as elsewhere, it ends in a mud cliff of about thirty feet in height. Structurally Flaxman Island, which is about three miles long and half a mile wide, is merely a portion of the tundra, its surface lying about twenty feet above sea-level. It is covered with scattered ponds, and boulders also lie half-buried in the soil. Seaward the island ends in a clay cliff, which is gradually receding, the contained boulders being washed out as it recedes, forming a rock-strewn beach. The cliff is cut up by many gullies, and wherever there is a good exposure ice is always seen beneath the soil. The exposure of ice varies in depth from a few feet to twenty feet, but nowhere can the base be seen. In some places the ice can be traced thirty or forty feet inland from the cliff by means of canyons worn by surface water. Thirty yards from the cliff pure ice was found on digging through one foot of frozen soil and one foot of frozen clay. The observations made indeed point to the fact that the whole island has an underlying formation of ground ice, which is being worn away with some rapidity at the seaward side, but is elsewhere preserved by the surface covering of soil and the severity of the climate. Where the ice was exposed it was seen to be coarsely granulated and full of minute air-bubbles; it must be either glacier ice or snow granulated by great age. The nature of the overlying deposit at once suggests glacial drift. The boulders are very markedly striated, and are of very heterogeneous nature. In the total absence of any indication of the base of the ice, which is remarkably clean, it seems clear that the ice must be as old as the drift on its surface. The facts then suggest that the island is simply a portion of an ancient glacier which has been protected from melting by the surface layer of drift. A chain of mountains about three thousand feet high bounds the tundra of the mainland on its inner side, and through these the Kugura river breaks, coming from the higher peaks beyond. It seems probable that formerly the valley of this river was filled by a glacier which reached the sea, and the author believes that Flaxman Island is a remnant of this glacier, protected from disappearance by its thick coating of drift.

If the ice which underlies the tundra along the mud cliffs, which are such a common feature along Northern Alaska, is of the same granulated type as that on Flaxman Island, it would not appear that Schrader's suggestion that it is due to the freezing of bodies of standing water can hold. Mr. Leffingwell suggests that it also is a remnant of the glacial period produced in this way:—During that period snow must have accumulated in the coastal region, which is much colder than the interior. When the climate grew warmer silt was brought down by

the mountain streams and distributed over the surface of the snow. In this silt mosses and grass took root, forming a covering of peat. This covering protected the underlying ice from melting wherever it was sufficiently thick. Where it was not thick enough the ice melted, leaving the depressions which now form the characteristic ponds and lakes of the tundras.

An author ("V.S."), discussing the foregoing paper in the March number of the *Bulletin of the American Geographical Society*, states that he *has* observed the base of the ice on Flaxman Island, at another season of the year, and finds the layer to be not more than four feet deep. He is disposed to doubt the truth of Mr. Leffingwell's suggestion, and to support rather that of Mr. J. B. Tyrell (cf. this *Magazine*, xx. p. 435), who believes that such ice-sheets are formed by the welling up of water through fissures in the frost layer, and its freezing into vast but relatively thin sheets of ice.

General.

The International Congress of Geography.—We have received a copy of the *Livret des Excursions*, a pamphlet giving a detailed analysis of the proposed excursions to be held in connection with the Congress at Geneva. In vol. xxiii., p. 550, we gave a general account of these excursions, and are now requested by the Committee to remind intending participators that all applications for the excursions preceding the Congress should have been received by June 1, while applications for those which follow the Congress must be received on or before July 1. The pamphlet can be obtained on application to M. Emile Chaix, Avenue du Mail 23, Geneva, at a price of 1 fr. 50, or can be consulted in the Society's Rooms. The Society is to be represented at the congress by Mr. J. G. Bartholomew, Hon. Sec.; Major Forbes, Secretary; and the Editor. Nearly 200 papers and reports are already arranged for the meetings of the Congress, which is to meet in fourteen sections, and a large number of distinguished geographers are expected to take part in the proceedings. Various receptions and entertainments have also been arranged for the members.

Earthquake Phenomena.—Professor J. Milne delivered a discourse on earthquakes before the Royal Institution in March, which is reported in full in *Nature* for April 23. The discourse contains many points of geographical interest. Professor Milne, at the outset, points out that no widespread interest is taken in seismological phenomena in this country, a fact due doubtless to the rarity and insignificance of these phenomena here. Modern developments of commerce have, however, made this apathy quite unjustifiable, for earthquakes in other countries deeply affect, for example, insurance companies here. Professor Milne then goes on to give some account of the work being done by other countries in this connection, and urges the need of increased interest, both on the part of individuals and of the government, in the subject. In the course of the paper he also discusses some very interesting side-issues

which have emerged from the study of earthquakes, some of which are of great scientific importance. Without stopping here to discuss the interesting points which have arisen from a study of the light effects frequently observed at the time of large earthquakes, we may pass on to some geographically interesting points connected with fault formation. Professor Milne states that in his opinion the great majority of earthquakes, and certainly all large tremors, originate from the formation of extension of faults. Very striking, for instance, was the fault which opened at the time of the San Francisco shock. The largest fault which has arisen in geologically recent times is that which formed the Great Rift Valley in Central Africa, which is 4000 miles long. If, says Professor Milne, we extend the Great Rift Valley in imagination, both in length and breadth, we find that it becomes a trough comparable to that which holds the waters of the Atlantic. In the Rift Valley a strip of country has been let down, and a study of the globe will show that the contours of the Old World and the New show a remarkable complementary resemblance. At the same time the Atlantic Ridge forms the reflection of the European and North African western coastline. Further, the rocks on the European side show a remarkable resemblance to those on the American side in corresponding latitudes. The Atlantic may be compared to a canal, the banks of which are symmetrical in form and in geological material. The suggestion thus presents itself that it was formed by two parallel Rift Valleys, one to the west and one to the east of the submerged backbone of the ocean.

In a subsequent issue of *Nature*, the following interesting letter by Dr. William S. Bruce appears :—

"In Prof. J. Milne's discourse at the Royal Institution which appeared in *Nature* of April 23 is given an interesting map on p. 593 showing the folds and probable direction of fault lines in the Atlantic. In that map is shown the mid-Atlantic 'rise' extending to about 40° S. The map, however, would have been more interesting had Prof. Milne included in it the recent Bathymetrical researches of the *Scotia*, which were described in a preliminary paper in the *Scottish Geographical Magazine* in August 1905. Here it is shown that the Scottish expedition sounded out this 'rise' for a thousand miles further south than Prof. Milne has marked it, and also that 'rise' has probable connection with another running in a more or less ENE. and WSW. direction from the south of South America through South Georgia and the Sandwich Group, and also from Graham Land, Antarctica, through the South Orkneys and the Sandwich Group, thence passing eastward through Bouvet Island to Madagascar and the east coast of Africa. The extension of the mid-Atlantic 'rise' continues the reflection of the South American continent, and again the transverse 'rise' reflects the hypothetical and known portions of the coast-line of Antarctica."

The British Association.—Some further details are forthcoming in regard to the arrangements for the Dublin meeting of the British Association. During the week of the meeting excursions will be arranged to the Devil's Glen and Glendalough in County Wicklow, to Powerscourt Waterfall and the Dargle near Bray, to the Boyne Valley, and to the Shannon Lakes. Mr. Francis Darwin's presidential address

is to be delivered on the evening of September 2 in the large hall of the Royal University, and Professor Davis's lecture on the Colorado Cañon on Monday, September 5, in the same place. It is expected that for the most part the serious work of the sections will be over by two o'clock, leaving the afternoons and evenings free. Various social entertainments are already promised. The reception room and administrative offices will be located in Trinity College, and the handbook is being prepared by Mr. R. Lloyd Praeger and Professor Grenville A. J. Cole, and will include sections on the local geology, botany, zoology, history and archæology, and commerce and industries. The complete list of officers in Section E (Geography) is as follows:—President: Major E. H. Hills, C.M.G., R.E. Vice-Presidents: George G. Chisholm, M.A., B.Sc.; Rev. W. Spotswood Green, C.B., M.A.; J. G. Bartholomew, F.R.S.E.; Captain H. G. Lyons, R.E., D.Sc., F.R.S. Secretaries: O. J. R. Howarth, M.A. (Recorder); W. J. Barton, B.A.; E. A. Reeves; W. F. Bailey, C.B.

Science at the Franco-British Exhibition.—Science is represented at the Franco-British Exhibition by a special court, where the exhibits are arranged under the head of each of the great sciences. Illustrations are given of the exploration of the heavens, the air, the sea, and the land, the exhibits being classified under the headings of the sciences of astronomy, meteorology, oceanography, geography and geology. Among the exhibits is a very complete astronomical observatory, and it is hoped also to have a meteorological observatory actually in work in the grounds. The court contains an area of about 14,000 square feet, and a plan showing its arrangement is given in *Nature* for April 30.

Personal.—We learn with pleasure that Mr. J. G. Bartholomew, Hon. Sec. of the Royal Scottish Geographical Society, has been appointed a corresponding member of the Imperial Russian Geographical Society.

Commercial Geography.

The Novi-Bazar Railway.—Advices from Constantinople, dated 16th April last, were to the effect that engineers from the Public Works Department, and those deputed by the Oriental Railway Company, had left for Mitrovitza, while the staff officers from the War Ministry were expected to leave on 16th April. The survey of the projected railway from Uvac to Mitrovitza will be undertaken at four points simultaneously, and the work is expected to be completed within five months.

The Economic Condition of Egypt.—The *Bollettino della Società Geografica Italiana* for February contains a notice on the present economic condition of Egypt which is of interest at this time. It is based on Lord Cromer's Reports for 1907, and on another report sent by the Belgian Consul-General at Cairo to his government. Figures are given demonstrating the prosperity of the country, and an important argument is instanced to show that this satisfactory condition rests on a solid

basis. Egypt, as is well known, has been in a state of crisis lately, due partly to the financial disturbances which have unsettled America. The reflex uneasiness which has spread over Europe has been accentuated in Egypt, owing to that country being the happy hunting-ground of all sorts of speculative operators. Numerous banking establishments of indifferent character have sprung up, only to topple over with the first strain, and a good deal of distress has been created. In spite of all this, the economic condition of Egypt has been unaffected. Imports and exports have gone on in an uninterrupted course of development. It is noted that Italy is not holding her own either in imports or exports, in spite of her geographical proximity.

EDUCATIONAL.

The following is of interest in connection with geographical teaching in Scotland :—At a meeting of the Glasgow University Court, held on May 7, the Clerk reported that the Committee on the proposed lectureship on geography had resolved to recommend to the Court that the lectureship should be instituted, and the subject taught on a standard equal to the graduation course for Arts and Science, and that it be remitted to the Committee to confer with the Finance Committee as to providing the necessary funds. The recommendation was approved of.

Professor Russell Smith contributes an article entitled "Geography with a Purpose" to the *Bulletin* of the Geographical Society of Philadelphia (October 1907). The article gives a brief account of the geography courses of the University of Pennsylvania. These are associated with a School of Finance and Commerce, and the subject is treated almost exclusively from the human side. In other words, the *causes* of land forms are not primarily considered, but in the first instance the relation of these land forms to human activity in the region. As a side issue it is stated that the scientific causes of the particular forms often comes up, but the investigation of these is not the primary object of the course, which is to consider man's response to his physical environment. Similarly, in political geography each nation is studied with respect to the influence which physical environment has played and is still playing in the trend of national activity both in domestic and foreign affairs. The course covers the leading countries of the world and thus becomes a course in comparative geography. The economic and commercial geography of the United States are then studied in some detail as an introduction to a more advanced course on International Trade. There is also a course on climate in which the economic responses to climate are studied in detail, this being the course which comes nearest to pure geography. Professor Smith states that the emphasis laid on the human side of geography at the University of Pennsylvania is greatly increasing the interest being taking in the subject there, and that the number of students of geography is large. Though there is much that is

interesting in his account of the courses, yet it seems to suggest certain dangers. An obvious remark is that while it is possible to arrive at a consensus of opinion, in regard to all essential points, among physiographers as to the origin of, for example, a particular mountain chain, the formulation of the type of human character produced by the effect of the chain is a more delicate matter, in which as yet the personal equation enters largely. Again, the account of the courses seems to suggest also that there is a real danger of their becoming too utilitarian, that commercial geography, for instance, may be studied, not for its scientific interest, but merely as a means of learning the great art of money-making. Though we all desire that geography should be studied as a subject of direct human interest, as the inter-relation of man and his environment in the widest sense, yet we must surely remember that its justification in an educational course is that it affords or should afford an insight into the methods and results of modern science. It is in our opinion an error to seek to show that its main justification is a directly utilitarian one.

In the *Journal of Geography* for December last there is an article on the Stereoscope in School which teachers will find of interest. The author emphasises the relative uselessness of the ordinary "one-eyed" picture, which is apt to convey very little to those unfamiliar with the scene or object portrayed. Most teachers probably have found great difficulty in getting the audience to see in a photograph, even a good photograph, the merest fraction of what the person who took the photograph perceived. We have already dealt here with the value of stereoscopic pictures, but the difficulty in practice has always been that each child in the class should have both a stereoscope and a copy of each picture, if any serious study has to be done, and considerations of cost make this impossible except on a very small scale. The writer of the article gives his experiences of an attempt to make stereoscopic pictures for himself. A suitable camera can be bought without great outlay, and he found the pictures easier to take than the ordinary type. He took twenty-nine dozen photos, and counting in the cost of the camera and all other charges found that the prints cost about threepence each. Reproductions of these prints could, however, be sold at about sixpence a dozen. These figures suggest that there is a great future before stereoscopic views if commercial houses can be brought to understand the requirements of teachers and the necessity for cheap reproductions.

Among the numerous papers which are continually appearing on various aspects of botanical geography, we may note here two of special importance. Space will not permit of a full summary of either, but the subject is one of such interest, and the modern developments so striking, that many teachers may be glad to have their attention called to the papers. Professor Charles Flahault, "the master of botanical geography in France," has recently published a paper on the progress in this subject since 1884, which is summarised in *La Géographie* for February 15. The point of view may perhaps be suffi-

ciently indicated by two quotations:—It is impossible to understand man as a geographical element, without in the first place considering the place of vegetation, the study of which is the necessary introduction to human geography. Again—if we can read and analyse the vegetation of a district, we can determine the main lines of possible development, agricultural and human. The last dictum suggests methods of correlating systematic botany—often rather a dreary subject—in schools with the geography lesson.

The other paper to which we wish to draw attention is a detailed study of the soil conditions and plant associations of the region of Chaux-de fonds (near Neuchâtel), and appears in the *Bulletin de la Société Neuchâteloise de Géographie* (xviii.). The special conditions analysed are a little foreign to our experience here, but the careful treatment of plant peculiarities in relation to local conditions of soil and climate are of great interest to the geographer.

NEW BOOKS.

EUROPE.

Baedeker's Spain and Portugal. Third edition, with 9 Maps and 57 Plans. 1908. *Price* 16 *marks.* Leipzig: Karl Baedeker. London: Dulau and Co.

The increasing popularity of Spain and Portugal as a spring and autumn resort for British tourists renders a new edition of Baedeker's invaluable handbook specially welcome. No doubt changes proceed slowly in the Spanish Peninsula, but nevertheless an examination of the work shows that the editor's revision has been no light task. Although sixteen shillings may seem a high price for such a small volume, we venture to think that the traveller in Spain will probably find it his most profitable investment in the way of outfit.

Baedeker's Southern Italy and Sicily. Fifteenth revised edition, with 30 Maps and 28 Plans. 1908. *Price* 6 *marks.* Leipzig: Karl Baedeker. London: Dulau and Co.

This volume not only suffices for the South of Italy but takes the traveller to the neighbouring attractions of Malta, Sardinia, Tunis, and the charming island of Corfu. In this new edition, besides the usual revision, many improvements are visible in the maps, notably that of Capri.

Murray's Handbook for Rome and the Campagna. Edited by Norwood Young. Seventeenth Edition. 1908. With 96 Maps and Plans. *Price* 10*s.* London: Edward Stanford.

Among the noteworthy features of this new edition of Murray's *Rome* is the complete bringing up to date of the Directory, which comprises a list of hotels and their rates, with the latest information as to galleries, museums, and other public buildings. The Introduction which follows contains contributions by various specialists on History, Architecture, Sculpture, Painting, etc. Following the usual plan adopted in Murray's Guides, the treatment of the sights of the City and Suburbs is dealt with in forty-two routes, judiciously selected to cover the whole ground. The recent excavations at the Forum have necessitated complete

revision of that section, and this has been done under the supervision of Comm. Boni, whose name, now well known as one of the greatest living authorities on the subject, is sufficient guarantee that nothing of interest has been omitted.

ASIA.

Icebound Heights of the Mustagh. By Fanny Bullock Workman, Officier de l'Instruction Publique de France, etc., and William Hunter Workman, M.A., M.D., F.R.S.E., etc. London : Archibald Constable and Co., Limited, 1908. *Price* 21*s. net.*

The first of the two mountaineering expeditions, of which this most interesting and beautifully illustrated book contains the record, took place in the summer of 1902, and was briefly described in a note in the issue of this *Magazine* for the month of November in that year. The second of the expeditions took place in the summer of the following year, and our readers will doubtless recollect that Mrs. Bullock Workman was good enough to forward to us a condensed account of what had been accomplished in it, which appeared in the January number of this *Magazine* in 1904. The volume now before us gives us a detailed account of the inception, progress and success of each of these expeditions. With regard to their inception and success Dr. Workman explains that "as regards the Karakoram Watershed south of the Hispar glacier, it may be said, in the two expeditions described in this volume, we attacked it repeatedly, partly because the glaciers we were exploring culminate in its cols and passes, and partly because we had a hobby for finding a new caravan passage over it with the following results. The cols at the head of the Sosbon and Hoh Lumba glaciers are separated from the Hispar by a glacier and a high mountain ridge. These cols are corniced, and overhang perpendicular precipices several thousand feet in height. Next to the west, following the range, comes the Alchori Col, difficult of access from the south, and falling to the Hispar by a precipice on the north. Then the cols above the two branches of the Alchori also overhang the Hispar, but are inaccessible from either side. From the Kero Lungma two glaciers that might lead to the Hispar were found also to be inaccessible. Next in order is the Nushik La, a practicable pass, but one seldom crossed in the last twenty years. From the upper tributaries of the Chogo Lungma we ascended two high cols, which proved to be impracticable as passages. The Chogo La, at the head of the Chogo Lungma, would furnish a passage to the west, probably to Hispar, to a party of thoroughly equipped mountaineers, but it would not be available for coolies on account of the long and difficult march up the Chogo Lungma and the great ice-wall at its head of nearly 20,000 feet. The same is true of the Haramosh La, at the head of the Haramosh glacier, leading to the Indus and Gilgit. We have thus climbed or thoroughly examined twelve depressions in the ranges of this region, and have failed to discover any other available route from it to the north or west than the Nushik La, which is the only one over which a caravan could be taken." The party had intended to complete the work by crossing the Nushik La, descending the Hispar glacier, and thence making their way to Gilgit through the Hunza Nagar territory, but they were prevented from doing so by mutiny among the transport coolies, who were terrified at the prospect of travelling through the regions inhabited by their traditionary enemies and oppressors of the Hunza Nagar. Thanks to Mrs. Bullock Workman's kindness in sending to us an account of the progress of the expedition, it is unnecessary for us to recapitulate now what was published four years ago. In the second expedition she broke her former mountain record of 21,000 feet, twice in one day, by climbing to altitudes

of 21,770 and 22,586 feet, while Dr. Workman ascended to a height of 23,399 feet, on a peak estimated at 24,486 feet, thus acquiring the highest record for men. It will, however, be fresh in the memory of those who had the good fortune to hear Mrs. Bullock Workman's address to the Society in December last, that in July 1907 she succeeded in climbing to an altitude of over 23,000 feet on one of the peaks of the Nun Kun range.

It would be difficult to exaggerate the courage and endurance of the members of the party, or the skill and patience with which difficulties and dangers were met and overcome—and these not solely connected with the work of climbing, but also of managing the transport coolies, on whose co-operation the success or failure of the expedition to a certain extent depended. One danger, or, at least, difficulty, which it is hard for the ordinary reader to realise, arose from the heat. The sun-temperature of five consecutive days in June in the Shigar valley is recorded, and at about 1 P.M. it varied from 180° to 206° F. At an altitude of 17,322 feet a temperature of 204° F. is stated to be "not abnormally high," but the effects of the heat, reflected from the snow, are very severe on the skin of Europeans. This book is, of course, pre-eminently devoted to mountaineering and exploration of glaciers; but throughout it we have incidentally much interesting information regarding the economic conditions, agriculture, manners, etc., of the peoples through whose lands the party travelled; and much invaluable information is recorded for the benefit of any explorers who care to continue the work to which Dr. Workman and his wife have made such distinguished contributions. This book is equipped with two excellent maps. The feature, however, of the volume is its numerous and skilfully executed photographs, the work of the authors, for which we have nothing but unqualified praise. Without them, the letterpress would be of thrilling and absorbing interest: taken together, they form an unusually attractive and delightful volume, second to none of its many predecessors on mountaineering in the Himalayas.

The Book of Ceylon. By HENRY M. CAVE, M.A. (Oxon.), F.R.G.S. London, Paris, New York, Toronto, and Melbourne: Cassell and Co. 1908. *Price* 12*s. net.*

This is a most exhaustive work on Ceylon, and the author, a learned graduate of Oxford, is well qualified by long residence and travel throughout the island to speak with authority. His previous beautifully-illustrated work, *Golden Tips*, more especially referring to the Tea Districts and Tea Industry of Ceylon, is most excellent; but the present volume includes the whole island, its early Buddhist History and ancient monuments, the Portuguese and Dutch periods of occupation, and finally the English. No one who has read the book can plead ignorance of Ceylon.

There is probably no island in tropical seas that comes up to Ceylon; there may be some as beautiful, but they have not the same history, and monuments of an ancient civilisation. Ceylon, on the other hand, apart from its wealth of tropical vegetation, had a wonderful civilisation, and from it Buddhism spread to Burma and Siam, and possibly China. The Buddhists of Burma seem to have improved upon the Dagobas (shrines) of Anuradhapura. In the very ancient capital of Pagān on the Irawadi, the Pagodas, though ruined, far exceed in number, or even size, the Dagobas of Ceylon. Unfortunately the raids of the Tamils from Southern India destroyed the ancient cities of Anuradhapura and Pollonaruwa, and it was only in quite recent times that the Government of Ceylon took energetic steps to free the great Dagobas from the dense forests that had for

ages buried them from sight. The extraordinary native chronicle known as the Mahawansa, being a narrative of events in the history of Ceylon from before the Christian era down to the middle of the eighteenth century, and which was unknown until the nineteenth century to any but Buddhist priests, was discovered by the late Sir Emerson Tennant, at the time Colonial Secretary of Ceylon. It seems a fairly accurate history of events that took place in the island.

The late Dr. Norman Macleod, during his brief visit to Ceylon, a short time before his death, wrote of it as an earthly paradise, and though Bishop Heber described it as such, in his famous missionary hymn, and that nought but *man* in it was vile, it is said that in the original the word was "Java," not Ceylon, the good bishop at the time he composed the hymn having just returned from Java.

For any one visiting Ceylon the book is a perfect mine of information, as there is scarcely a place or thing connected with it that is not touched upon, and in a very readable manner. The only fault—if fault there be—is that it is over photographed, a number of the small photographs might, we think, have been left out with advantage.

Descriptions of the gigantic tea and rubber enterprises, for which, since coffee died out in a great measure, the island is now famous, are given. At the end of the book much useful information for visitors to the island is given, but the volume is too bulky to carry about like a Baedeker.

The Coming Struggle in Eastern Asia. By B. L. Putnam Weale. With Map and Illustrations. London: Macmillan and Co., Ltd. 1908. *Price* 12*s.* 6*d. net.*

This striking forecast of the future in the Far East is based on an examination of the actual and potential strength, the industrial characteristics, and the political ideals of Russia, Japan, and China. It deserves careful consideration, not least from those who find themselves unable to endorse its conclusions.

Strength, we are told, is the first impression given by Eastern Russia, and it is the last;—strength not connected as yet or co-ordinated, but individual, latent, undeveloped. At present its development is retarded by laziness and ignorance: had it not been that everybody almost was indifferent and careless, Port Arthur would never have been lost; had there not been gross ignorance, even in the highest quarters, the 106 miles of railway which supply the key to the Sungari wheat plains would never have been ceded to Japan. But beneath all lies an unexploited substratum of power. Even as things are now the author singles out for praise the skill that made use of the long railway as an effective engine of war, and the management of the hospitals when once the enormous distance to be traversed had been overcome. The main source, however, of Russian strength in Eastern Asia lies in Siberia. Siberia is accessible by river and by land, it offers a vast area of cultivable land to immigrants, the immigrants themselves are distinguished by fecundity and by vigour of breed. The destiny of Russia depends on the efforts of her people, and these efforts ought to be studied most of all in the great empire that is in making between the Ural and Lake Baikal.

In sharp contrast to these easy-going giants, whose strength lies in their animal health, and the main cause of whose weakness is their total want of education, are the trained and alert Japanese with their attention to detail, their exactitude, their desire for profit. It cannot be said that the writer is unfriendly to the Japanese; he acknowledges as above praise the patriotism that pervades the whole people, he admits the rare power shown by their leaders of forming clear and detached views of the best means of advancing the national progress. He instances the skill by which in 1897 Japan took her place among the gold-standard countries

without any disturbance or commotion in her markets, and the ability with which she financed the late war with Russia, raising as much as possible at home by means of short loans. He is however evidently convinced that their aim is slowly and gradually, by a cautious step-to-step process, to build up Greater Japan, a Japanese empire which will differ from the British in two essential features. It will be a work of deliberation and set purpose, each definite forward movement being firmly cemented before a further advance is made, and it will not be based on the principles of the "open door" and "equal opportunity for all," but the markets of the new empire will be practically closed to all the world except Japan. Such is the case already with Formosa, and to a great extent with Korea, and will eventually be the case with Southern Manchuria. With this determination Japan, instead of developing its own internal possibilities, is devoting its energies to creating an army, which by 1915—the date of the expiration of the Anglo-Japanese alliance—will amount to 2,000,000 men, and to building up a navy which already, in 1908, is at least three times as strong as was the navy in February 1904.

It remains to consider the attitude of China. For the first time China seems absolutely honest in the desire for progress. Thus since the Russo-Japanese war can be traced a definite attempt to reform the administration by an augmentation of the salaries of all descriptions of officials in order that they may be able to live on their pay; another sign is the commencement of the only sound system of railway construction, so long as railways have to be constructed by foreigners. The line as it is completed is to be handed over, section by section, to the Chinese Government, and the foreign contractors are to retain no interest whatever in the operating of the line. On the other hand dangers are ahead. The Manchu dynasty is still comparatively modern—some two and a half centuries old; there is not only discontent but, for the first time, what may be called revolutionary unrest is manifesting itself; the military force at the disposal of the Government is small; the prominent officials are still divided by rivalry; there is a growing suspicion among the more intelligent Chinese of the reiterated assurances of foreign powers that the main aim of their policy is the preservation of the integrity and independence of the Chinese empire; it is the consciousness of these dangers that explains the second great tendency of modern Chinese statesmanship, to adopt measures that will tighten the Manchu hold over provincial China.

The elements of dispeace in the East are there, and the construction of the Panama Canal may be the prelude of a struggle between the yellow and the white races. But the author believes that American foreign and colonial action will rather take the direction of the south, of Ecuador, Peru, and Chili, than of China or Japan; he therefore the more earnestly warns his countrymen not to rely on paper or promises, but to maintain to the full their naval power in the Pacific waters.

AFRICA.

Modern Egypt. By The Earl of Cromer. 2 vols. London: Macmillan and Co., Ltd., 1908. Portrait, Map, and Index. *Price* 24*s. net.*

It rarely occurs that the public have the opportunity to study contemporary history as recounted by one of the leading actors in it. Here the story comes from the pen of the man who was admittedly, in recent years at all events, the central figure in the drama. Yet Lord Cromer has found it possible to publish an account written with great fulness and with perfect frankness of criticism, and has done so with an ordered and luminous manner of presentment so striking as almost to

disarm criticism. The quality of inevitableness appears to attach to the book as it did to so much of his work. Let us trust that the superstructure will be worthy of the foundations he has laid.

It is not our intention to deal with the volumes in detail after the very full treatment which they have so recently received from the public press. The trying scenes in which General Gordon figures have naturally attracted first attention, and they are of intense interest. But the whole work teems with interest. It is the story of a triumph of administration, and of indomitable persistence and pluck in the face of quite exceptional difficulties. Moreover, Lord Cromer has done his best, and with his admirable powers of exposition he cannot fail to bring home to his countrymen and others the lessons of his experience by fruitful comment, warning, and encouragement. The work enhances the debt which both Britain and Egypt already owe him. Before quitting it, we ought to note the wide area of literature which Lord Cromer has laid under contribution for his purpose.

Egypt, and How to See It. Illustrated by A. B. Lamplough. London: Ballantyne and Co., Limited, 1908.

Whilst giving all the usual information contained in the ordinary guide-book, the special feature of this little book is that it also gives a foretaste of the scenery and life of the country in the form of charming coloured pictures reproduced from the artist's sketches. It is also useful as a summary of what is most worth seeing in that land of many attractions.

AMERICA.

La Colombie Britannique: Étude sur la colonisation au Canada. Par Albert Métin. Paris: Librairie Armand Colin, 1908. *Price* 12 *francs.*

This is a detailed account, geographical, historical, economic, of one of our youngest colonies, and one so little known that at present barely one-fifth has been surveyed. By the aid of the excellent map at the end of the volume, based on the Relief-Map of Canada 1904, the distinctive features of the land can be studied under the divisions of the Maritime Range—the mountains of Vancouver Island and of the Queen Charlotte Archipelago which, rising from a submarine plateau, form a prolongation of the Canadian mainland—the Coast Range, the Interior Plateau, which is the northern extremity of the great dry belt of Mexico and of the States, and the Triple Range of the Gold Mountains, the Selkirks and the Rockies. The Interior Plateau contains the real "divide" in the Cassiar Mountains, the Omineca Mountains, and the Caribou Heights, and there is another line, though not so easily to be traced, that divides the two great forests, the Northern and the Western. The former, with its smaller conifers, extends northwards to the Yukon, and makes part of the great forest which runs in a north-easterly direction to the shores of Hudson's Bay. The latter has for its distinguishing trees the Douglas pine, the white cedar, and the giant hemlock, and before the coming of the Europeans covered alike islands and highlands.

The coming of the Europeans had one marked influence on the Indians, who till then had inhabited the land in families or Totemic clans. The hunting and fishing, which had been merely a source of livelihood, became a source of gain. The Indians began to slaughter right and left, and would themselves have destroyed their own means of existence had not the newcomers interfered to preserve what is now a great national asset. The reserves for the natives them-

selves have been formed on the site of and in the neighbourhood of Indian villages and camps, and are grouped under nine agencies, of which a map is added. The writer then turns to the other great difficulty of a young colony—the regulation of immigration, which is the more perplexing because immigrants are needed and the demand for labour exceeds the supply. This is in truth an imperial rather than a colonial question, and can only receive adequate solution, while there is yet time, by the collective wisdom of the Empire guided by the vaster experience and backed by the greater strength of the mother country.

The last and most important division of the work deals with the enormous potential wealth of British Columbia, its forestry, its agriculture, its fruit culture, its fisheries, and above all its minerals. Here pre-eminently prosperity is "Ancilla Metalli": the miner's claim leads to the mining camp, with its store, its bar, its lock-up, though Columbian mining camps are marked by less disorder than is prevalent in those of the United States. Then comes the more stable population, the builders, the joiners, the plumbers, the metallurgists, the printers, the electricians, the schoolmasters, the architects, and finally the roadmakers. For the railway and the tramcar precede the high road, and the main communications of British Columbia are as yet external, by sea and by land, rather than internal.

There is a picturesque account of the C.P.R., tracing the line till it reaches Vancouver terminus, "the meeting of the East and West." The danger of course remains that the great railway may become more powerful than the state, and the writer views with alarm the result of the elections of 1904, which gave to Canada a railway-owned government and not a government-owned railway.

The volume concludes with a warning as to the future, prompted by this sense of alarm. Speculators have indeed made and are now developing British Columbia, but they are too powerful. The great fisheries, the sawmills, the timber-trade, the smelting-works, are almost all in the hands of trusts, and the white society is too sharply divided into capitalists and wage-earners. The greed for gain is the dominating motive in this new country, partly because nature is as yet too strong to allow men leisure for much beyond the struggle to subdue her, and partly because British and American education agree at least in this, that they emphasise the making of money, and the turning to material use the riches of earth, of forest, and of water, as the chief end and highest ambition of man. With this paraphrase of its closing sentence we must conclude this brief notice of a book which is well worth perusal.

GENERAL.

La Science Séismologique. By Comte de Montessus de Ballore. Paris: Librairie Armand Colin, 1907.

Earthquakes, an Introduction to Seismic Geology. By William Herbert Hobbs. London: Sidney Appleton, 1908. *Price* 8*s. net.*

The publication of these two books is an index to the growing interest in a rapidly developing branch of geological science. The author of the first-named has already made valuable contributions to the literature of the subject, his statistical compilations especially being worthy of note. His familiarity with the original memoirs which have made modern seismology during the last quarter of a century gives a value to his book which we are sorry to say is not possessed by the smaller work prepared by Professor Hobbs. The latter seems to follow too slavishly very recent continental literature, and to be unfamiliar with much of the splendid work which Professor Milne and his colleagues executed in Japan fifteen and twenty years ago. Unfortunately also his explanation of the theory of the

horizontal pendulum at the foot of page 261 is quite wrong. Again, no one would know from the manner in which the author speaks of "the surprisingly simple formulas" devised by Laska and Omori for finding the origin of an earthquake disturbance that these formulas are simply Milne's spherical graphical method made *inaccurate* by being cast into algebraic form. The formulas in fact apply only within somewhat narrow limits of distance. On page 288 we are told that lower transit velocities to near stations are due to the lower rock densities which are traversed along the shorter and "crustal" chords, whereas it is well known that, other things being equal, a lower rock density must give a higher velocity. Professor Hobbs has omitted all mention of the elasticities as determining factors in the speed of propagation.

Although there is hardly a chapter in which we do not find some statement open to criticism, there is much in Professor Hobbs's book which is sound and suggestive. His descriptive powers are good, and many of the illustrations chosen are typically appropriate. Perhaps the most novel part is the discussion of what the author calls seismotectonic lines. Starting from one of de Ballore's maps of seismic frequency with its large and small dots indicating roughly the intensities of shock experienced at different centres, Professor Hobbs draws straight lines connecting sets of dots which are approximately linear, and regards these as hidden faults, or seismotectonic lines. In certain cases, undoubtedly, these lines are coincident with faults; but the general applicability of the method may well be called in question. The "hidden faults" indicated by this method in the case of Scotland have very little in common with what geologists tell us regarding the real great lines of fault. Similarly the seismotectonic lines drawn for Japan are quite incompatible with what is known regarding the positions of the origins of most of the shocks which disturb these islands. The lines are drawn on the basis of Davison's representation of Milne's catalogue of shocks between 1885 and 1892. But the details of this map are largely determined by the great Mino-Owari earthquake of 1891, which temporarily transformed a comparatively quiescent part of the country into one of marked seismicity—a fact which does not seem to be realised by Professor Hobbs.

Because of its greater size, M. de Ballore's treatise is, of course, the more thorough and complete. There is, indeed, no important point which is not touched upon in its pages. There is, moreover, a commendable maturity of judgment displayed. In fact, no geologist aiming at a fairly complete library should be without de Ballore's work. It is probably the best single-volumed treatise on Seismology which we now possess. It is pleasantly written and profusely illustrated with both pictures and diagrams.

The World's Peoples. By A. H. Keane, LL.D., F.R.A.I. With many Illustrations. London: Hutchinson and Co., 1908. *Price 6s. net.*

On such a vexed subject as Ethnology it is satisfactory to the ordinary reader to have placed in his hands, in modern compass, and at a most moderate price, an authoritative compendium such as this. Dr. Keane is a well-known expert, and and has succeeded in either describing or giving types of practically all the existing peoples of the world. The fact that the index of the volume contains between 800 and 900 entries is evidence of detail and compression, but, notwithstanding this, the interest of the writing is unfailing. Technical terms, such as Amarind (a word not yet fully adopted on this side of the Atlantic), have not been altogether avoided, but they are carefully explained. The illustrations are admirably selected.

BOOKS RECEIVED.

We have received the following new books, which will be reviewed in due course :—

Illustrated Pocket Guide to Melrose, Abbotsford, etc. (The Land of Scott.) By Ralph Richardson, F.R.S.E., F.S.A.Scot. Third Edition. Cr. 8vo. Pp. viii + 61. Edinburgh : John Bartholomew and Co., 1908. *Price* 6*d.*

In Indian Mexico : A Narrative of Travel and Labour. By Fredrick Starr. Imperial 8vo. Pp. xii + 415. 160 Illustrations. Chicago: Forbes and Co., 1908.

The Discovery and Settlement of Port Mackay, Queensland. With numerous Illustrations, Charts and Maps, and some Notes on the Natural History of the District. By H. Ling Roth. 4to. Pp. viii + 114. Halifax : F. King and Sons, Limited, 1908.

La France au Soleil : Notes sur l'Algérie. Par Henry de Bruchard. Préface de Maurice Barrès. Pp. 164. Paris : E. Sansot et Cie., 1908. *Prix* 3 fr.

African Nature Notes and Reminiscences. By Frederick Courtenay Selous, F.Z.S. With a Foreword by President Roosevelt and Illustrations by E. Caldwell. Demy 8vo. Pp. xxx + 456. London : Macmillan and Co. *Price* 10*s. net.*

Rock-Climbing in Skye. By Ashley P. Abraham. With 30 full-page Illustrations in Collotype, 9 Diagrams of the Chief Routes, and a Map. Demy 8vo. Pp. xxiv + 330. London : Longmans, Green and Co., 1908. *Price* 21*s. net.*

Les Dépôts Marins. Par le Dr. Léon W. Collet. Avec 35 figures dans le texte et une carte hors texte. Crown 8vo. Pp. 325. Paris : Octave Doin, 1908. *Price* 5 fr.

Mediterranean Winter Resorts : A Complete and Practical Handbook to the Principal Health and Pleasure Resorts on the Shores of the Mediterranean, with Special Articles on the Principal Invalid Stations by Resident English Physicians. By Eustace Reynolds-Ball, F.R.G.S. Sixth Edition. Pp. xxxiii + 646. London : Hazell, Watson and Viney, Ltd., 1908. *Price* 6*s. net.*

Australia. ("Romance of Empire Series.") By W. H. Lang. With 12 Reproductions from Original Drawings in Colour by G. W. Lambert. Demy 8vo. Pp. xvi + 300. London : T. C. and E. C. Jack, 1908. *Price* 6*s. net.*

To-Day in Palestine. By H. W. Dunning, Ph.D. Illustrated from Photographs. Demy 8vo. Pp. viii + 278. London : T. Werner Laurie, 1908.

Jerusalem : The Topography, Economics, and History from the Earliest Times to A.D. 70. By George Adam Smith, D.D., LL.D. In two volumes. With Maps and Illustrations. Demy 8vo. Vol. I., pp. xxiv + 498. Vol. II., xvi + 631. London : Hodder and Stoughton, 1908. *Price* 24*s. net.*

The Andes and the Amazon : Life and Travel in Peru. By C. Reginald Enock, F.R.G.S. With a Map, 4 Coloured Plates, and 58 other Illustrations. Second Edition. Royal 8vo. Pp. xvi + 379. London : T. Fisher Unwin, 1908. *Price* 21*s.* (Presented by Eduardo Lembche, Chargé d'Affaires au Pérou.)

From Edinburgh to India and Burmah. By W. G. Burn-Murdoch. With 24 full-page Illustrations in Colour from Paintings by the Author. Demy 8vo. Pp. xiv + 403. London : George Routledge and Sons, Ltd. *Price* 10*s.* 6*d. net.*

The Statesman's Year-Book : Statistical and Historical Annual of the States of the World for the Year 1908. Edited by J. Scott Keltie, LL.D., with the assistance of J. P. A. Renwick, M.A., LL.B. Forty-fifth Annual Publication. Crown 8vo. Pp. lxxxiv + 1712. London : Macmillan and Co., 1908. *Price* 10*s.* 6*d. net.*

Bush Life in Australia and New Zealand. By Dugald Ferguson. Crown 8vo. Pp. xii + 361. London: Sands and Co., 1908.

From Peking to Mandalay: A Journey from North China to Burma through Tibetan Ssuch'uan and Yunnan. By R. F. Johnston, M.A., F.R.G.S. With Map and Illustrations. Demy 8vo. Pp. xii + 460. London: John Murray, 1908. *Price* 15*s. net.*

Norway at Home. ("At Home Series.") By Thomas B. Willson, M.A. Crown 8vo. Pp. xii + 228. *Price* 5*s. net.*

South Africa at Home. ("At Home Series.") By Robert H. Fuller, M.A. (Oxon.). Crown 8vo. Pp. xiv + 236. *Price* 5*s. net.*

America at Home. ("At Home Series.") By A. Maurice Low. Crown 8vo. Pp. xii + 231. London: George Newnes, Ltd., 1908. *Price* 5*s. net.*

A Scientific Geography. Book I.—The World. By Ellis W. Heaton, B.Sc., F.G.S. Crown 8vo. Pp. 305. London: Ralph, Holland and Co., 1908. *Price* 2*s.* 6*d. net.*

La Suisse au XX^e^ Siècle: Étude Économique et Sociale. Par Pierre Clerget. Un Volume in-18. Pp. 268. Paris: Armand Colin, 1908. *Price* 3 *fr.* 50.

La Grande Ile de Madagascar. Par Marius-Ary Leblond. Demy 8vo. Pp. 320. Paris: Librairie Ch. Delagrove, 1908.

Svenska Turist-föreningers Arsskrift för ar 1908. Pp. 438. Svenska Turistföreningen (The Swedish Touring Club). Stockholm, 1908.

Also the following Reports, etc. :—

British Museum (Natural History) Guides.

Guide to the Gallery of Fishes in the Department of Zoology. Illustrated. Pp. 209. *Price* 1*s.*

A Guide to the Exhibited Series of Insects. Illustrated. Pp. 60. *Price* 1*s.*

A Guide to the Elephants (Recent and Fossil) exhibited in the Department of Zoology and Palæontology. Illustrated. Pp. 46. London, 1908. *Price* 6*d.*

Transactions of the Highland and Agricultural Society of Scotland. Vol. xx. Edinburgh: William Blackwood, 1908.

Mata-Hari oder Wanderungen eines indonesischen Sprachforschers durch die drei Reiche der Natur. Von Professor Dr. R. Brandstetter. Luzern, 1908.

Growth and Decay of the Mexican Plateau. By Robert T. Hiel. New York, 1908.

Department of Botanical Research of the Carnegie Institution of Washington. Annual Report. Washington, 1908.

Leitfaden der Karlenentwurfslehre für Studierende der Erdkunde und derer Lehrer. Bearbeitet von Prof. Dr. Karl Zöppritz. Leipzig, 1908.

Les Variations Périodiques des Glaciers. XX^me^ Rapport 1906. Par Dr. Ed. Brückner *et* E. Muret. Berlin, 1908.

Memoirs of the Geological Survey of Victoria. No. 6*: The Buffalo Mountains.* By E. J. Dunn, F.G.S., Director. Melbourne, 1908.

Das Klima von Davos nach dem Beobachtungsmaterial der eidgenössischen meteorologischen Station in Davos. Von Hugo Bach. Zürich, 1907.

Mission Scientifique du Ka-Tanga: Resultats des Observations Météorologiques. Par A. Lancaster. Dix-septième Mémoire. Bruxelles, 1908.

Report on the Administration of the Punjab and its Dependencies for 1906-1907. Lahore, 1908.

Publishers forwarding books for review will greatly oblige by marking the **price** *in clear figures, especially in the case of foreign books.*

THE SCOTTISH

GEOGRAPHICAL

MAGAZINE.

NOTES ON THE SUB-ANTARCTIC ISLANDS.

By W. S. Pillans, F.R.S.G.S.

(With Maps.)

Far away in the Southern Ocean to the south of New Zealand are several groups of uninhabited islands which are believed by geologists to be the tops of the mountains of a submerged continent of which New Zealand formed a part. These islands have come into notoriety, not on account of their natural fertility or products, but because they lie in the track of vessels trading between Australian ports and Europe, *via* Cape Horn. The prevailing winds in these latitudes are westerly, and the weather generally thick and foggy, with the result that many a good ship, posted "missing" at Lloyd's, has been wrecked with the loss of all hands on the rugged cliffs which form the westerly coasts of these rock-bound islands.

For some years depôts of provisions, with huts and boathouses furnished with boats, have been established by the New Zealand Government on the islands for the benefit of castaway mariners who may be so fortunate as to reach the shore alive. The New Zealand Government's steamer *Hinemoa* takes annually a trip round these islands in order to see that the depôts, etc., are in good order, and to bring away any survivors of the crews of vessels that may have been wrecked there during the previous twelve months. The *Hinemoa* visits the Snares, Auckland, and Campbell groups, and the Antipodes and Bounty Islands. Through the courtesy of the Minister of Marine of New Zealand the writer of these notes was permitted to go as a passenger on the *Hinemoa* during her last trip, and perhaps a short description of these remote British possessions may interest the readers of the Royal Scottish Geographical Society.

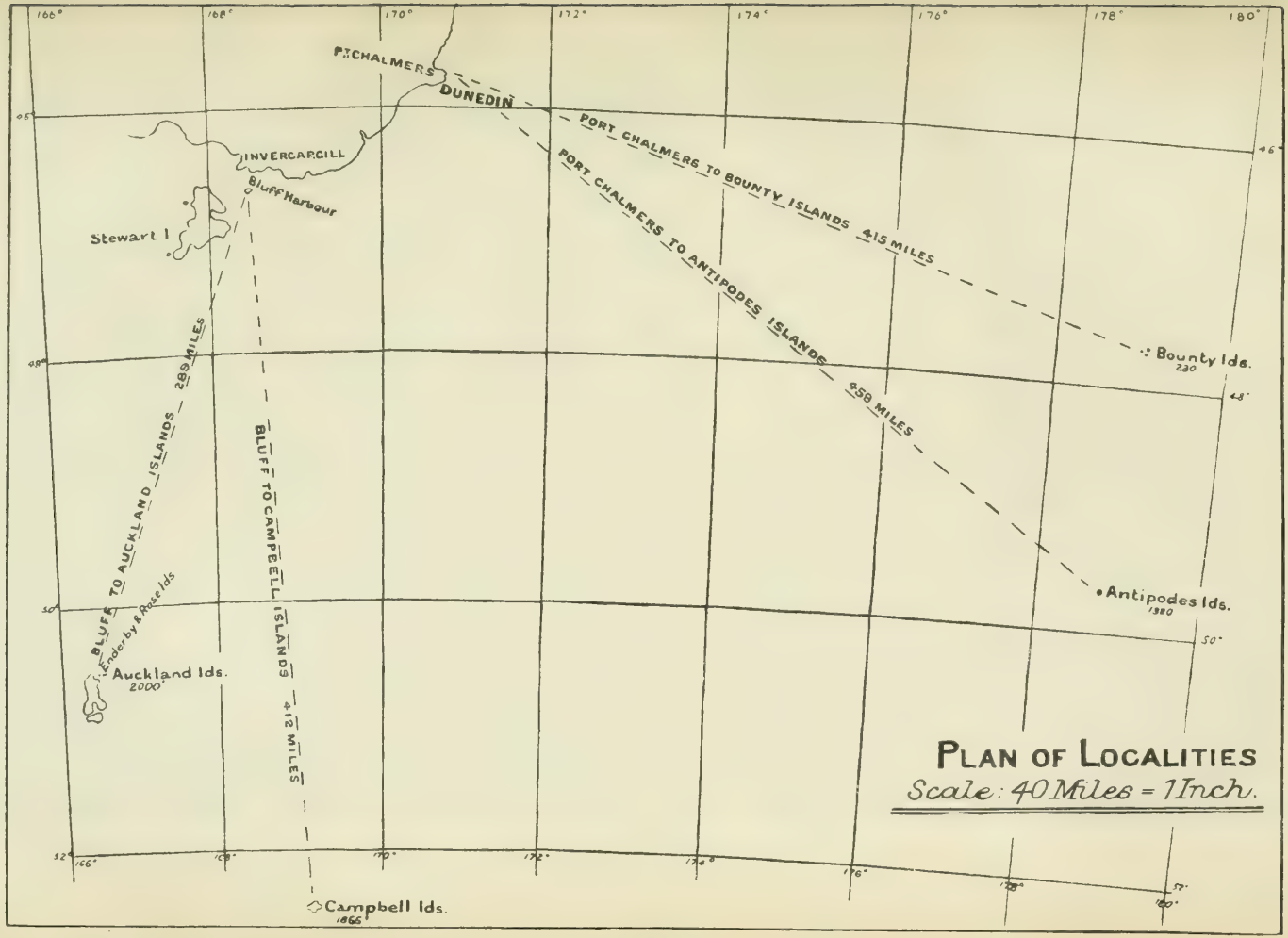
The Snares.

These islands, situated about sixty miles south of the southern extremity of New Zealand, in 48° 6′ S. lat. and 166° 29′ E. long., were first

visited. They consist of one large island, over a mile long and about three quarters of a mile wide, and several smaller islets and outlying rocks. They have steep rocky shores, and, more particularly on the western side, precipitous cliffs. The Auckland Islands, 150 miles further south, bear an evil reputation by reason of the wrecks and loss of life *known* to have occurred there, but it is probable that the Snares have taken a still greater toll of life and shipping, though the records of such disasters are few because there have been no survivors to tell the tale. The Snares lie not only in the track of vessels going round Cape Horn from Australia, but also of those coming to New Zealand ports from Europe *via* the Cape of Good Hope.

Before landing we went in the boat with flaring torches into a deep cave, disturbing a large Fur Seal which dashed past the boat to gain the entrance, and also through a long natural tunnel in the cliffs. There was little more than room in some places for the boat to pass through, but in others the roofs of both cave and tunnel were high and vaulted, giving back resounding echoes to the shouts of our Maori crew. On approaching the landing-place near the depôt our boat was surrounded by several large Sea-lions—a gigantic kind of seal. They came quite close to the boat, roaring defiance at us, and sometimes biting viciously at the blades of the oars. There are large numbers of tufted and crested Penguins breeding all over the island, and on approaching their rookeries the clamour and smell are almost overpowering. Several other kinds of sea-birds were also breeding on the island. One of these, the Southern Skua or Sea-hawk, is most rapacious in its habits. This bird, called by ornithologists *Megalestris antarctica*, is very similar in appearance to its congener the Great Skua (*Megalestris catarrhactes*) or Bonxie of the Shetland Islanders, which is now nearly extinct. Round the nests of the Sea-hawks we found the mangled remains of a great variety of sea-birds —Cape Pigeons, Mutton-birds, and more than one variety of the smaller Petrels, beside the shells of innumerable eggs that had been stolen from the penguin rookeries. It is wise to take a stick to defend yourselves with, as the Sea-hawks are very bold and fierce in the defence of their nests, dashing down savagely on the intruder. A photographer of our party was knocked down by one of these birds which swooped down on him while he was engaged in photographing its nest and young ones. Mutton-birds and smaller varieties of Petrel were also nesting in burrows in the peaty soil and under the ledges of rocks, and it is said that that most beautiful little sea-bird the Cape Pigeon (*Daption capensis*) also breeds here, though we did not find any of their nests. The white-capped Mollymauk is also said to breed on the Snares toward the end of January, but we were more than two months too early to find them nesting.

It is strange, if these islands were ever joined by land to New Zealand, that none of the flightless birds, such as the Kiwi, Kakapo, and Weka, which inhabit the south-west of the Middle Island and Stewart's Island are not found on the Snares. There are, however, several curious land-birds, some of which are not found in any other part of the world; notably the Snares Snipe (*Gallinago heugeli*). These birds, though they can fly, are not strong on the wing, and several were caught by hand.


166°
168°
170°
172°
174°
176°
178°
180°
46°
48°
50°
52°
PT. CHALMERS
DUNEDIN
INVERCARGILL
Bluff Harbour
Stewart I
PORT CHALMERS TO BOUNTY ISLANDS 415 MILES
PORT CHALMERS TO ANTIPODES ISLANDS 458 MILES
Bounty Ids.
230
Antipodes Ids.
1320
BLUFF TO AUCKLAND ISLANDS 289 MILES
BLUFF TO CAMPBELL ISLANDS 412 MILES
Enderby & Rose Ids
Auckland Ids.
2000'
Campbell Ids.
1866'
PLAN OF LOCALITIES
Scale: 40 Miles = 1 Inch.

There is also the tawny Fern-bird (*Sphenœacus fulvus*), and a beautiful little jet black Wood Robin (*Miro dannefordi*) also peculiar to the Snares.

The tops of these islands, which rise to a height of several hundred feet, are clothed with coarse tussocks and other grasses. Lower down, and reaching in some places on the east coast almost to high-water mark, is bush composed of a robust shrub known to botanists as *Olearia lyallii*, which is here of a very gnarled and distorted habit of growth consequent on the exposed situation. In the bush are innumerable tracks and paths made by the furred and feathered inhabitants, and it is interesting to meet bands of Penguins on their way to and from the sea, or come upon a Sea-lion sleeping peacefully in the shelter of the bush. The soil is peaty, and there is near the depôt a small stream of dark, porter-coloured water.

Goats were turned out some years ago on the Snares with a view to affording food for shipwrecked mariners. For some time they seemed to thrive fairly well, but have since gradually died out, and Captain Bollons, the commander of the *Hinemoa*, told me he did not believe there was now a single live goat on the islands, which he attributes to the continual cold and wet of this inclement climate. The Snares were discovered by Vancouver in 1791.

Auckland Islands.

The next islands visited were those of the Auckland group about 150 miles south of the Snares, 50° 48′ S. to 166° E. They were discovered in 1806 by Captain Abraham Bristow in the ship *Ocean*, belonging to Samuel Enderby, and were called after Lord Auckland. Bristow returned the following year in the *Sarah*, and took formal possession of the islands in the name of Great Britain. He turned out pigs, the descendants of which are still fairly numerous in some parts of the Main Island.

In later times sheep have been turned out but they have not thriven, though some still survive. It is believed that, not being tended and shorn, the long fleeces of several years' growth, when saturated with rain, become so heavy that the unfortunate animals have not the strength to carry them, especially where the soil is soft and boggy, and so sink and perish from exhaustion. Goats have done somewhat better, and on Enderby Island, where there was formerly a considerable whaling station, cattle and rabbits are fairly abundant.

The indigenous fauna of the Auckland Islands is very interesting and comprises several birds which are not to be found elsewhere, viz. the Flightless Duck (*Nesonetta aucklandica*) and the Auckland Island Shag (*Phalacrocorax colensoi*), both of which are numerous along the shores of some of the islands. There is also a Sea-duck called the Southern Merganser (*Mergus australis*) which inhabits bays and inlets. It is very rare, and so far as I know none were seen by any member of the expedition. It is believed by naturalists to be identical with the Merganser which inhabits the Northern Hemisphere and is also found in Brazil. It is puzzling to think how these birds got to the Aucklands when it is remembered that there are none of the species nearer than Brazil.

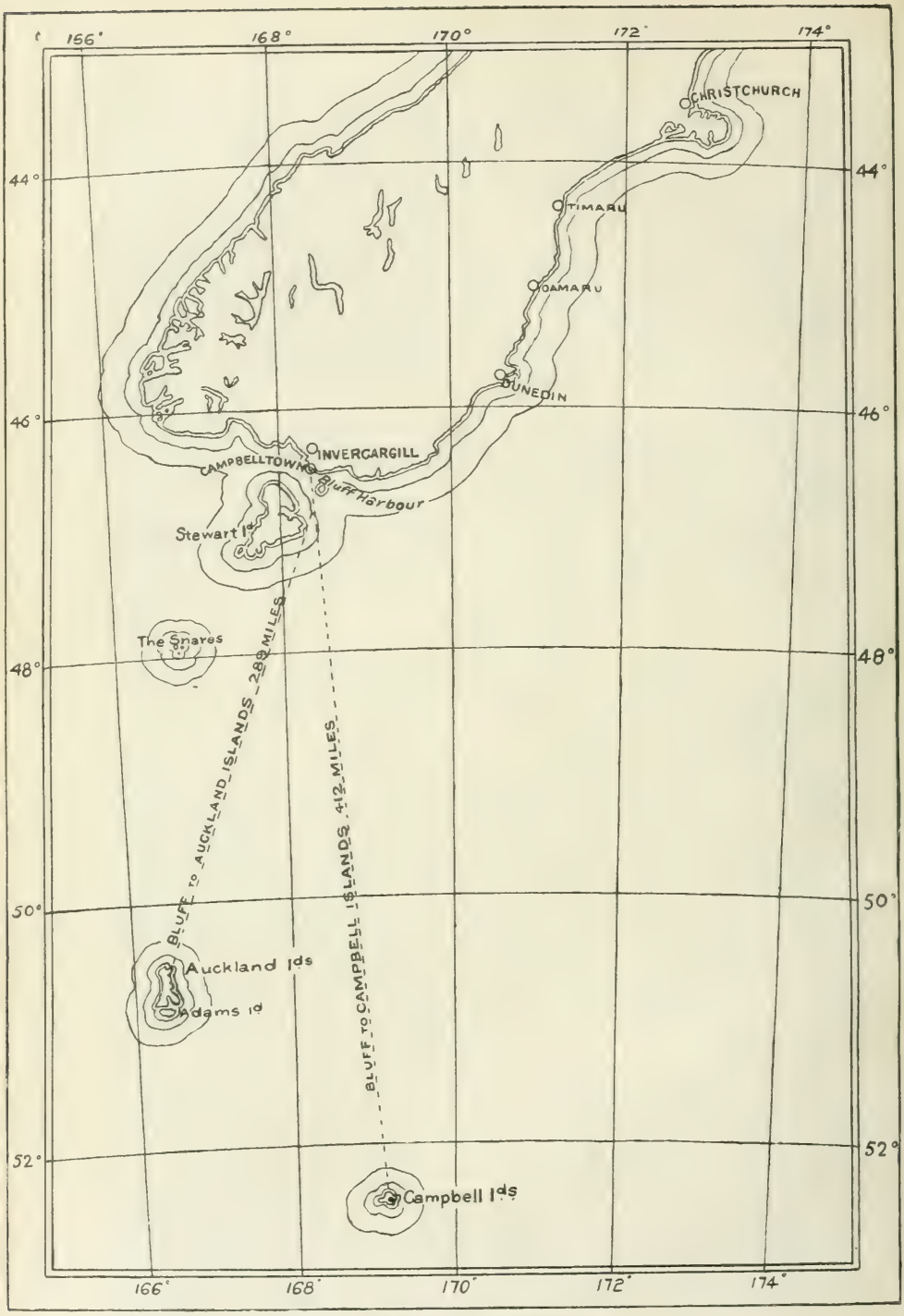
Penguins, Petrels of several kinds, and Whale-birds (*Prion banksi*) and (*P. capensis*), also two kinds of Terns and the small Gulls, *Larus scopulinus* and *Larus bullerii*, nest on these islands, and are as usual tyrannised over by their enemies the Sea-hawks. Those most magnificent of all sea-birds, the Royal Albatross (*Diomedea regia*) and the Wandering Albatross (*D. exulans*), breed on Adam's Island, the most southerly of the group. The Sooty Albatross (*Phoebetria fuliginosa*), and at least one species of Mollymauk build along the tops of the cliffs. Those most ubiquitous of sea-birds, the Black-backed Gulls of the Southern Hemisphere (*Larus dominicanus*), were met with on all the islands we visited during the trip. This bird is almost as rapacious in his habits as his northern congener (*Larus marinus*), so often seen on the British coast.

The bush which clothes the sides of the inlets from the water's edge to in some places five or six hundred feet up the hills, is composed for the most part of a kind of Rata or Iron-wood, gnarled and twisted into weird and grotesque forms by the strong winds.

In these gloomy and damp forests may be seen the Tui or Parson-bird, the Red-fronted Parrakeet, and the Yellow-breasted Tit, and occasionally one hears the sweet notes of the Bell-bird. No doubt the presence of these New Zealand land-birds is a strong argument in favour of the theory that these islands were once joined by land to New Zealand. There are also some other land-birds peculiar to the Aucklands. A snipe (*Gallinago aucklandica*), a Sand Plover (*Thinornis rossi*) and a Rail (*Hypotænidia mülleri*). The Quail Hawk of New Zealand (*Hieracidea Novæ Zealandiæ*) is also common.

The mammalia are represented by the Fur Seal (*Arctocephalus forsteri*), which are now very scarce and shy, and the Sea-lions (*A. hookerii*), which are still fairly numerous and bold. The former were at one time very numerous, and attracted to these islands many sealing vessels whose crews slaughtered them in great numbers; from 25,000 skins and upwards was no uncommon cargo for one sealing trip, according to the records and logs of sealing vessels at the beginning of last century. The sealing ventures were mostly in the hands of Sydney merchants, and a good many of the cargoes were sent to Canton.

The Sea-lion is one of the largest varieties of seals. Some of the old males are splendid fellows with manes like lions, and look very formidable when they stand up on their fore flippers and roar at you. They are not the least afraid, and if you go too near, think nothing of charging you, when you have to be very smart in getting out of their way—as they can run nearly as fast as a man on a smooth beach and faster than a man over rough rocks or in thick bush. They bring their hind flippers forward and use them as legs, and are in this respect quite differently formed from the seals one meets with on the Scottish coast and Shetland Islands, whose only means of progression on land is by wriggling themselves along on their bellies by the aid of their fore flippers. It is really surprising how fast Sea-lions can go, as their gait on land is most unwieldy, though in the water they are most agile and swift. They also seem to travel about a great deal, as their well-worn paths show; and



MAP SHOWING POSITION OF
AUCKLAND AND CAMPBELL ISLANDS
RELATIVE TO THE MIDDLE ISLAND
SCALE, 100 MILES=1 INCH

Captain Musgrave in his *Narrative of the Wreck of the "Grafton"* mentions having found tracks of seals nearly to the tops of the mountains, and about four miles from the water. They open their mouths very wide when they roar, showing a truly formidable set of teeth. The males are of a brownish black colour, and many of the old ones are fully 12 ft. long and must weigh close on a ton, or even more, when fat. The females, called "sea bears" by the sealers, are generally timid, and are much smaller than the males and of a dirty yellow colour.

The Auckland Group consists of five islands. The largest, called Auckland Island, is 30 miles long, with an average width of 15 miles, and contains 114,200 acres. It is very rough and hilly, the highest hill, Mount Eden, at the head of Port Ross, being 1325 ft. high. The next largest island is in the extreme south, and is called Adam's Island. It rises to a height of about 2000 feet, and contains 2500 acres. The other islands are Disappointment Island to the north-west, and Enderby, 1580 acres; Ewing and Rose Islands, 415 acres, to the north-east. Like all the Sub-Antarctic islands, this group is bounded by high rugged cliffs on the western side, but on the eastern side is indented by many inlets affording safe anchorage. There are three Government depôts for castaway mariners, viz. at Port Ross, Norman's Inlet, and at the western end of the Western Arm of Carnley Harbour.

When we visited Port Ross on the 16th November 1907, we found at the depôt the 15 survivors of the four-masted barque *Dundonald*, which had been wrecked on Disappointment Island on the 7th of March previous. The captain, his son, and 10 of the crew were drowned at the time of the wreck, and the first mate, after succeeding in getting ashore, died of exposure. The survivors subsisted on sea-birds and seals and the tuberous roots of a plant known to botanists as *Stilbocarpa polaris*, for seven months, and after dreadful hardships, at last succeeded in making a boat of canvas stretched on a frame of sticks, by means of which four of them eventually reached the main island, and after finding the depôt, returned in the Government boat to the rescue of their shipmates.

On Disappointment Island large numbers of Mollymauks breed. Young Mollymauks (and also young Albatross) remain in the vicinity of the nests where they were hatched for nearly twelve months, and the parent birds come at intervals and feed them, and only turn them out and desert them when preparing to lay in the early spring. It is probably to this habit that the survivors of the *Dundonald* are indebted for most of their sustenance. All through the winter there were plenty of these fat, overgrown nestlings, nearly as big as their parents, and yet unable to fly, thus falling an easy prey to the hungry mariners. Had the nestlings of the Mollymauk, like those of most other birds, become fledged and flown away a few weeks after hatching, the castaways would have fared considerably worse than they did. They seemed very glad to see us, poor fellows, though when we found them they were in good plight—living in the depôt hut, where they found clothing, stores, and a rifle and cartridges, with which they kept themselves supplied with beef by shooting the cattle on Enderby Island.

The Auckland Islands have been the scene of many shipping disasters and much loss of life:—the *Grafton* and *Minerva* in 1864; the *General Grant* in 1866, when 73 lives were lost; the *Derry Castle* in 1887; the *Campadri* in 1891, and the *Anjou* in 1905, all being wrecked there. The captain and most of the crew of the *Daphne* (a small craft sent down to search for the treasure believed to be in the wreck of the *General Grant*) were drowned when passing through Adam's Straits in a whale boat. The *Daphne* was not lost, as was at one time reported, but was sailed back to New Zealand by the cook (a Kanaka) and a boy, the sole survivors of her crew.

After leaving a band of scientists and their staff, a party of 14, at the depôt in Carnley Harbour, the *Hinemoa* proceeded on her course.

Campbell Island.

This island, the only one of those we visited which has any permanent human inhabitants, was next visited. It is sometimes called the Campbell Group, but is really one large island, with several small outlying rocks. The area is 28,000 acres, and it is taken up as a sheep run. There are at present about 10,000 sheep, which are tended by three shepherds who all hail from the Shetland Islands. There are several hills in Campbell Island over 1200 ft. high, the highest peak, Mount Honey, being 1866 feet in height. There are two good harbours on the east side, named North East Bay and Perseverance Bay, and the west coast, as in all the Sub-Antarctic groups, is rock-bound and precipitous.

Campbell Island is situated in long. 169° 09′ E. and lat. 53° 34′ S., and was discovered by Captain Fred. Hazelburgh in the brig *Perseverance* in 1812. There is practically no bush, only narrow belts of scrub in some places round the shores of the inlets. This scrub is a kind of grass-tree (Epacrid) known to botanists as *Dracophyllum*. The land, which is of a very peaty nature, is covered with rough tussock grass, except where the grass has been eaten out by the sheep, in which places the land is completely taken possession of by a kind of lily with a yellow flower called *Bulbinella Hookeri*. It is said that pigs are the only animals that will eat the bulbinella, so I suppose when the sheep have eaten out all the grass, they will have to be taken off, and a pig ranch started to take the place of the sheep run, unless English grasses are found to thrive there, which is doubtful.

All the sea-birds I have mentioned as inhabiting the Aucklands are to be found here, with the exception of the Wandering Albatross, and perhaps also the Mutton-bird. There is also a Campbell Island Shag (*Phalacrocorax Campbelli*), but this is so nearly allied to the Auckland Island Shag that it is doubtful if they are distinct. One member of our party reported having seen a pair of House Sparrows which had their nest in some rocks. Linnets were also reported to have been seen. How these birds got there is a puzzle. They must have got blown over from New Zealand, as it is most unlikely that they were imported by man.

The writer was also surprised to see a pair of Godwits which, from

their movements, appeared to have a nest not far off. The Godwit is a bird that breeds in Liberia, and makes annual migrations to New Zealand, where it rarely (if ever) breeds. This pair on Campbell Island must surely have lost their bearings, and gone south instead of north to find a breeding place.

A few Fur Seals and plenty of Sea-lions are still to be seen at Campbell Island, and it is stated that the Sea Elephant (*Macrorhinus leoninus*) is sometimes met with.

The French astronomical expedition stayed for some time on Campbell Island in 1874, to observe the transit of Venus. There still remain evidences of their occupation and the graves of some of the Frenchmen who died there. The ruins of the huts of some of the old time sealers and whalers are also visible. After landing another party of scientists and their camp equipage to camp in the scrub on the shore of Perseverance Harbour, about a mile from the sheep-station, the *Hinemoa* continued her journey.

Antipodes Island.

This island is distant 400 miles east of Campbell Island, and lies to the SE. of New Zealand, in lat. 47° 44′ S., and long. 178° 20′ E. The island has an area of 1450 acres, and there are several outlying islands and rocks near it. It received its name because it is the nearest land to the true antipodes of Greenwich. As a matter of fact it is not very near, as the true antipodes of Antipodes Island is somewhere near Barfleur, in France.

There are two boat landings on the east side, and also a fairly safe anchorage sheltered from the prevailing westerly winds. The top of the island is clothed with tussock grass and other rough herbage, and cattle were turned out in 1889, and also in 1903 and 1904, but from all accounts they and nine sheep put on the island in 1888 have all died out. They evidently cannot stand the continued cold and wet of that awful climate.

A vessel called the *Spirit of Dawn* was wrecked on the Antipodes in 1893. The captain and five others were drowned, and the survivors, eleven in number, do not seem to have had the pluck and enterprise of the *Dundonald's* men. They did not explore the island, but remained near the place where they landed for eighty-seven days, living on the raw flesh of sea-birds and suffering great hardships from exposure, when all the time they were within a very short distance of the depôt, where they would have found plenty of provisions and clothes and a hut to shelter them. On the eighty-eighth day they were found by the *Hinemoa* and taken to New Zealand.

There are swarms of sea-birds nesting on the Antipodes, principally Penguins, *Catarrhactes Chrysocome*, the tufted Penguin, and *C. alateri*, the big crested Penguin, whose rookeries run down to close to high water mark. There is also a curious little bird peculiar to the island called the Antipodes Island Lark (*Anthus steindachneri*) which flits about the penguin rookeries, picking up the insects with which they are infested. The Antipodes Island Parrakeet (*Cyanorhamphus cyanurus*) is

also unknown elsewhere. There is another bird called the Yellowish Parrakeet (*Cyanorhamphus erythrotis*), but this bird is also found in the Macquarie Islands.

Strange to say there are no Seals or Sea-lions on the Antipodes. I do not know whether they were exterminated by the sealers or whether they never existed there at all. The fact remains that they are not there—with the result that the sea round the island swarms with fish. While we were lying at anchor in the *Hinemoa* some of the crew started fishing. No sooner were the lines down than the baits were taken, and the fish hauled as fast as possible, often two at a time. The fish caught is nearly allied to the blue-cod of the New Zealand coast, and is delicious eating, and "all hands and the cook" revelled in fish for dinner and next morning's breakfast.

Bounty Islands.

These islands, which were next visited, form a group of six rocky islands, with a total area of 335 acres, and are situated in lat. 47° 44′ S., and long. 179° 7′ E., 110 miles north of Antipodes Island. They are a wonderful sight, as they are practically 335 acres of birds sitting nearly as close to each other as turnips in a turnip field. There are no land-birds, and practically no vegetation exists. Penguins and Molly-mauks seem to be in millions, and as you wade through among the nesting birds they attack your legs viciously, and the noise and stench are appalling. The places where the Penguins can land are few. I sat for some time near one of the landings, and it was very interesting to see the bathing parties come in from the sea, land on the top of a roller, and scramble up the bank. There was a continuous stream of them, and they met a continuous stream of dirty Penguins going down for a dip. It was amusing to see how the clean ones shied off the dirty ones. They mostly kept to their right, and were a very orderly crowd, reminding one of human beings passing to and fro in a crowded thoroughfare—say Princes Street, Edinburgh, on a Saturday evening. There is something inexpressibly funny in the gait of the Penguin as he waddles along swinging his flippers like arms.

There also are considerable numbers of a beautiful little Whale-bird (*Prion Slateri*) sometimes called the Dove Petrel. When nesting these birds sit in pairs on the rocks and coo to each other just like Doves.

We saw no Sea-lions, but Fur Seals, of which a few still remain, were once very numerous, and it was the habit of the old time sealers to land a boat's crew on the islands, and leave them to camp there for weeks, and kill seals. How they managed to exist in that clamour and stench is a marvel. They must have stretched a sail to catch rain water for drinking, for all the springs on the islands must be more or less polluted.

The Bounty Islands were sighted by Bligh and named after the British ship *Bounty*, of which he was commander when her crew mutinied in 1789 at Tahiti, afterwards settling in Pitcairn Island. The only land between the islands and the antarctic continent is the Macquarie Islands. These, though exploited in the matter of penguin and sea elephant oil

by a New Zealand firm, belong to the Tasmanian Government, so are not within the beat of the *Hinemoa*. On some of the older maps there appear the Emerald Isle to the south-west of Campbell Island, and Cornwallis Island about half-way between the Bounty and Chatham Island. The *Times Atlas*, published 1895, has Emerald Isle only. As a matter of fact neither Emerald nor Cornwallis Island exist.

The geological formation of all the sub-antarctic islands is chiefly volcanic. In many places the basalt cliffs present a very imposing and picturesque appearance. In Campbell Island, however, there are reported to be sedimentary formations of Tertiary age, and marine fossils have been found in limestone deposits.

From the Bounties the *Hinemoa* returned to Campbell, a distance of 480 miles, and had a most tempestuous voyage. After taking on board the Campbell Island contingent of the Scientific Expedition, we steamed to the Aucklands, where we picked up the scientists we had left there, and also the survivors of the *Dundonald*, and then sailed for the Bluff, New Zealand.

The whole trip round the islands, which takes from ten days to a fortnight in the month of November, is, to a lover of Nature, delightful—but the climate is almost without intermission most tempestuous. It is sometimes possible for a visitor to New Zealand, by applying to the Minister of Marine, to obtain a passage on the *Hinemoa*, but the writer would not advise any one to go but a hardy, active man, and one who does not suffer from seasickness, however rough it is. One thing, however, I can guarantee, is the greatest courtesy and kindness from the captain, officers, and crew of the *Hinemoa*.

Above all, let no one go expecting to make a haul of ornithological specimens. The New Zealand Government is most strict in its protection of the birds and their eggs. I applied for a permit to take some specimens for a museum in which I am interested in England, and received a telegram from the Colonial Secretary to the effect that I must not touch any protected birds or their eggs. The protected list includes Penguins, Petrels, and Gulls, which is pretty comprehensive. "Penguins" means all varieties of penguins, "Petrels" includes all the petrel tribe from the Albatross, Mollymauk, and Mutton-bird, down to the little Diving-petrel not much bigger than a lark, and "Gulls" comprises pretty well every other sea-bird with the exception perhaps of Shags.

The *Hinemoa* is a beautiful yacht-like vessel of 282 tons—length 220 feet, beam 25 feet. She is employed going round the coast supplying the lighthouses with stores, etc. She also makes an annual visit to the Kermadec Islands, which are also under the New Zealand Government.

The Scientific Expedition, to which I have several times referred, was under the auspices of the New Zealand Government, and composed of many of the leading scientists of the dominion. There were botanists, zoologists, geologists, entomologists, ichthyologists, magnetic observers, and photographers, and when the results of their researches, which they intend to publish in book form, is given to the world, we shall probably learn all that is to be known of the Sub-antarctic Islands.

THE SOUTH ORKNEYS IN 1907.

By R. C. Mossman, F.R.S.E.

(*With Illustrations.*)

It will be remembered that since the departure of the *Scotia* from the South Orkneys in February 1904, the meteorological and magnetical station established there by the Scottish Expedition in March 1903 has been continued under the auspices of the Argentine Meteorological Office. I am indebted to Mr. Walter G. Davis, Director of this Government Department, for permission to give the following account of the work carried on during the past year under the direction of Mr. Angus Rankin, the leader of the party. Mr. Rankin and his colleages left Buenos Aires on 13th December 1906. The South Orkneys were sighted on the 23rd, but owing to the heavy pack ice which surrounded the islands a landing was not effected till the 26th. The ice in Scotia Bay was unbroken, so that the year's store of coal and provisions had to be conveyed over

New Meteorological Station at the South Orkneys.

the ice a distance of two miles. The Argentine gunboat *Uruguay* with the relief party for the current year under Mr. W. R. Bruce, F.R.A.S., arrived in the vicinity of the islands on February 6th, but owing to thick fog the relief was not effected till three days later. The vessel remained till the 13th, the ship's officers and crew under the command of Lieutenant Jorge Yalour giving every assistance in the work of installing the new party. This was a matter of much difficulty owing to the heavy surf breaking on the beach. As the result of continuous head winds and high seas, Ushuaia in Tierra del Fuega was not reached till March 5th.

During the past year the routine hourly meteorological observations have been maintained without the break of a single hour, the completeness of the work reflecting great credit on Mr. Rankin and his staff. Not only are the observations all tabulated and reduced, being virtually ready for the printer, but Mr. Rankin has initiated several innovations, notably observations of the height of the clouds at

every hour of the day, and has also introduced a method of measuring the quantity of precipitation more satisfactory than any previously in vogue. Mr. Paulsen, the magnetic observer, carried on this important section of the work with the same thoroughness which characterised his observations when with the 1905 party, this being his second year as magnetic observer at the South Orkneys.

Looking at the meteorological records of the year 1907, a condensed abstract of which is given in Table I., many interesting features become apparent. The early part of the year was relatively mild, the months of February, April, and May having higher mean temperatures than hitherto recorded for these months. The mean temperature of February,

New Meteorological Station at the South Orkneys, another view.

34·5°, was the highest for any month in the five years covered by the observations. The mildness of May was remarkable, "Scotia Bay" remaining unfrozen until June 6th, which is the latest date observed, and in marked contrast to 1903, when the *Scotia* was firmly frozen in by the end of March. On May 11th there was a very high tide and heavy south-east gale, the sea coming right up to Omond House, exactly as happened on April 4, 1904. Immense ice boulders were strewn over the beach, some large ones being stranded close to Copeland observatory. The whole of May was unusually stormy and very mild, the mean temperature being 24·0°, a marked contrast to the corresponding month of 1904, where the mean was 10·4°. The total absence of cold weather is shown by the circumstance that the temperature did not fall to zero F. Precipitation was noted at no less than 365 hours out of a possible 744. In June and July the meteorological elements approximated

TABLE I.—ABSTRACT OF HOURLY METEOROLOGICAL OBSERVATIONS MADE AT LAURIE ISLAND, SOUTH ORKNEYS.
Lat. 60° 44′ S.; Long. 44° 39′ W.

Month.	Mean Barometric Pressure.[1] Mean.	Diff. from Average 1903-1907.	Highest.	Date.	Lowest.	Date.	Range.	Temperature. Mean.	Diff. from Average 1903-1907.	Highest.	Date.	Lowest.	Date.	Range.
	Ins.	Ins.	Ins.		Ins.		Ins.							
January	29·065	− ·188	29·429	12	28·499	7	0.930	32·7	+ 0·6	41·0	6	24·8	1, 2, 19	17·2
February	29·296	+ ·090	29·694	17	28·704	28	0·994	34·5	+ 2·3	47·8	14	27·5	11, 12	20·3
March	29·143	· ·016	29·870	17	28·325	10	1·545	32·1	+ 1·0	43·7	18	22·3	23	21·4
April	29·287	+ ·012	30·026	17	28·381	7	1·645	30·4	+ 4·5	41·9	2	18·3	22	23·6
May	29·031	− ·210	29·860	4	28·356	11	1·524	24·0	+ 6·3	37·2	18	1·4	12	35·8
June	29·268	− ·082	30·044	19	28·589	30	1·455	11·6	0·1	37·9	18, 19	− 27·0	16	64·9
July	29·473	+ ·076	30·482	26	28·356	6	2·126	10·3	+ 0·9	35·1	16	− 29·0	22	64·1
August	29·744	+ ·331	30·273	9	28·576	27	1·697	2·0	− 12·5	32·5	24	− 31·0	11	63·5
September	29·373	+ ·074	30·392	1	28·337	22	2·055	17·8	1·2	35·6	5	− 21·3	1	56·9
October	29·389	+ ·065	29·978	1	28·532	6	1·446	23·5	0·6	41·5	19	1·1	8	40·4
November	29·088	− ·132	29·731	2	28·268	24	1·463	28·8	− 0·8	40·8	4	8·4	2	32·4
December	29·384	+ ·090	29·871	19	28·849	7	1·022	29·4	1·2	40·1	5	20·3	8	19·8
				July		Nov.					Feb.		August	
Year	29·295	+ ·010	30·482	26	28·268	24	2·214	23·1	− 0·1	47·8	14	− 31·0	11	78·8

[1] Mean barometric pressure at 32°, sea-level, and standard gravity.

TABLE I. (*contd.*)—ABSTRACT OF HOURLY METEOROLOGICAL OBSERVATIONS MADE AT LAURIE ISLAND, SOUTH ORKNEYS.
Lat. 60° 44′ S.; Long. 44° 39′ W.

Month.	Cloud, (Overcast Sky or Fog = 10).		Sunshine.				
	Mean.	Diff. from Average 1906-1907.	Hours.	Mean Relative Humidity. Sat. = 100.	Hours of Precipitation.	Mean Wind Direction.	Mean Wind Velocity. Miles per hour.
January . .	9·4	0·0	62	84·5	189	WSW	8·4
February . .	9·4	+0·2	61	84·8	175	W	10·5
March . .	9·3	+0·1	32	84·5	237	W	11·8
April . . .	8·5	−0·1	59	83·0	171	W × S	11·5
May . . .	9·4	+1·4	6	91·0	365	W × S	13·4
June . . .	8·4	+1·0	2	90·1	278	W × S	12·3
July . . .	8·0	+0·7	15	92·7	228	SW × W	9·0
August . .	6·8	−0·8	62	93·0	160	SW	12·3
September . .	8·0	+0·2	85	95·3	264	WSW	12·4
October . .	9·0	+0·2	67	93·5	220	W	12·8
November . .	9·5	+0·4	49	90·4	318	W	9·9
December . .	9·7	+0·5	63	88·7	211	SW × S′	9·2
Year . . .	8·8	+0·3	563	89·3	2347	S 70° W	11·1

closely to their normals, an excess of cloud and absence of high temperatures being the most noteworthy features. July 21 and 22 were very cold, the average temperature of these days being −22·8°. The highest barometric pressure of the year, which is also the highest on record for the station, occurred on July 26th, namely, 30·482 [1] inches. From the 24th to the 30th of July pressure was unusually high, being 30·204 inches, and this was associated with low temperatures till the 26th.

TABLE II.—SOUTH GEORGIA, 1907.

Lat. 54° 14′ S., Long. 36° 33′ W. Hours 8-2-8.

	Mean Barometric Pressure.[1]		Mean Temperature.		Mean Amount of Cloud. Overcast Sky or Fog = 10.	
	Mean.	Diff. from four years' average.	Mean.	Diff. from four years' average.	Mean.	Diff. from average.
	Ins.	Ins.	°	°		
January .	29·141	−·181	44·4	+2·6	6·7	−0·6
February .	29·464	+·098	46·4	+4·4	6·9	+0·2
March .	29·416	+·045	42·1	+2·3	6·2	−0·8
April .	29·433	+·060	36·9	+1·5	6·3	−0·7
May .	29·176	−·176	36·9	+4·4	6·9	−0·1
June .	29·355	−·098	30·4	+0·9	6·5	−0·3
July .	29·547	+·057	29·0	+0·8	5·7	−0·7
August .	29·631	+·095	23·0	−6·9	5·7	−0·3
September	29·548	+·017	29·0	−3·6	6·8	+0·6
October .	29·668	+·255	33·0	−1·6	7·4	+0·1
November	29·249	−·044	37·1	−0·6	7·4	+0·2
December.	29·316	−·006	37·1	−2·6	7·6	+0·8
Year. .	29·412	+·010	35·4	+0·1	6·7	−0·1

[1] Mean barometric pressure at 32°, sea-level, and standard gravity.

August was a remarkable month, being not only the coldest month during the five years, but also having the highest mean barometric pressure. The mean temperature was 2·0° or 14·5° below the average, while the mean barometric pressure was 29·744 inches or 0·331 inches above the normal. The mean pressure from the 8th to the 15th was 30·061 inches, and the mean temperature from the 3rd to the 12th −14·8°, or 29·3° below the average August temperature. The lowest temperature of the year occurred on August 11, viz.—31·0°, this reading being 9° *higher* than the absolute minimum recorded on August 4, 1904. It is of interest to note that barometric pressure was 0·109 inch higher at the South Orkneys during the month of August than at South Georgia, some 400 miles to the north, showing a distinct inversion of the normal distribution of pressure in this region, which, as is well known, falls as we proceed south, at least for a certain distance,

[1] All barometric pressures are referred to 32°, sea-level, and standard gravity at lat. 45°.

determined by the proximity of the Antarctic continent. During the last week of July and the first three weeks of August, the effect of this unusual extension northward of the Antarctic anticyclone was clearly reflected in the abnormal distribution of pressure over South America. The usual state of matters at this season is in general a high-pressure area in the north of the Argentine Republic with a steady fall of pressure to the south. But the weather maps for the four weeks under review show a pressure distribution essentially different from the above. During this time there was a permanent low-pressure area in about 43° S. latitude, and 72° West longitude, which maintained its position from day to day with hardly any change of position until the 20th of August. Pressure to the south and east of this region rose, but the Antarctic anticyclone rarely showed itself on the Argentine weather charts. The position of the northern continental high-pressure area varied a good deal, but it was generally central in 30° to 35° S. between the longitudes of 62° and 69° West, while at the same time a low-pressure area is shown off the coast of Brazil on the same days. The interesting point, of course, is the way in which the storm centres, which usually pass to the south of Cape Horn, were forced to the north by the austral high-pressure area. Nothing can be said about the northern South Atlantic Ocean high-pressure area, but I have no doubt that it occupied an abnormal position, probably to the eastward of its usual situation. The weather records at St. Helena and Ascension, and observations taken by ships in the South Atlantic, will throw light on this point.

It is worthy of note that the cold of June, July and August was equally marked in both hemispheres between the meridians of 20° East and 100° West, or one-third of the circumference of the globe. Thus we have the following departures from the normal in the mean temperature of the three months under review :—

Northern Hemisphere.		Latitude.	Southern Hemisphere.		Latitude.
Copenhagen,	−3·2°	55° 41′	Tucuman,	−3·5°	26° 51′
Stockholm,	−4·2°	59° 21′	Cordoba,	2·5	31° 25′
Edinburgh,	−2·1°	55° 55′	Buenos Aires,	−2·2°	34° 37′
London (Greenwich),	−2·4°	51° 29′	South Georgia,	−1·7°	54° 14′
Vienna,	−1·5°	48° 14′	South Orkneys,	3·9	60° 44′

With regard to the United States, the same abnormal cold prevailed. In the *Monthly Weather Review* for August, p. 366, we are told that over the central and northern portions of the Rocky Mountain and Plateau districts the mean temperature of that month was nearly 5° below the normal, and over the Lake Region, Middle Atlantic States, and New England, from 2° to over 4° below the normal, "making the fifth consecutive month during which the temperature has been continuously below the average in these districts."

Is it possible that there is an intimate relation between pressure anomalies in the boreal and austral regions and the weather in intermediate situations both north and south of the Equator? I venture to think so, especially as regards those regions which bound the shores of the North and South Atlantic. During the three months under review barometric pressure was unusually high in the Greenland Sea and in

Iceland in the north, as well as (for most of the time) in the Antarctic, while pressure was low in the British Islands and over a considerable part of Europe, thus pointing to a displacement of the atmospheric "centres of action." It is to be hoped that the anomalous weather of the above period will be studied in detail, not for a restricted area, but for the whole globe.

During the spring and early summer months of 1907 low temperatures continued to prevail at the South Orkneys. Pressure was in excess of the average in all months except November, in which month the lowest barometer for the year—28·268 inches—was noted. This reading is in no way exceptional, being about 0·30 inch in excess of the absolute minimum. At the close of the year there was much ice around the islands, and Scotia Bay did not break up till 18th January 1908. Looking at the annual means, it will be seen that pressure and temperature both at South Georgia and the South Orkneys were in close agreement with the average, but, while the amount of cloud was much above the average at the South Orkneys, where there were 159 entirely overcast days, South Georgia had comparatively clear weather except in December. In this month there was a marked excess of east winds accompanying a slight inversion of the normal pressure conditions, pressure as in August being again higher to the south. The cloudiness accompanying east winds at South Georgia, as well as at the Falkland Islands, is due to the relative coldness of the ocean lying to the east of these islands which is again a result of the northward extension of the Antarctic "drift."

We are indebted to Mr. Paulsen for a careful study of animal life on the island during the year. Perhaps his most interesting capture was that of two Emperor penguins (*Aptenodytes forsteri*), one on the 4th, the other on the 31st of May. These birds were not seen during the wintering of the *Scotia*, nor in 1904, but in each of the last three years they have visited the islands, usually during the autumn and winter. Other species of Penguins continued to visit the station at this season, and on August 20th quite a large number of the Gentoo species (*Pygoscelis papua*) were found at the Rookery at Route Point on the north side of the islands. The annual return of the Adelia penguins (*Pygoscelis adeliæ*) took place on October 15, although a few were observed taking up positions on the rookeries a week earlier. Eggs were obtained in large numbers on November 6. The first Antarctic penguin (*Pygoscelis antarctica*) did not arrive till November 8th, the first eggs being obtained on the 29th. On this day a crested penguin (*Catarrhactes chrysolophus*?) was found occupying the same nest with one of the "ringed" species. While no great discoveries bearing on the natural history of the South Orkneys were made this last year, the capture of three Ross seals (*Ommatophoca rossi*) is not without interest, this being the rarest of the Antarctic seals.

In conclusion, one cannot help referring in a word to the enterprise of the Argentine Government in placing the South Orkney station on a permanent basis at an annual expenditure of £1500. Including the year's observations obtained by the Scottish National Antarctic Expedi-

tion, data covering five years are now available. The observations for 1904 are in the press and will be issued immediately, and the detailed values for the following three years will be in type about the end of this year, together with a complete discussion of the material for the whole period. The station on Wandel Island in 65° S., occupied by Dr. Charcot in 1904, will, it is hoped, be re-established next summer by the Argentine Meteorological Office. The most pressing necessity now is for one or two years' observations at a continental station in from 70° to 74° South, between the meridians of 40° and 70° West. In this way the full value of the meteorological observations at the South Orkneys would be obtained, and the causes of the ebb and flow of the Antarctic atmospheric circulation rendered apparent. Is it too much to hope that the great international Arctic scheme of meteorological investigation which led to such important results a quarter of a century ago will be revived at the other extremity of the globe in the immediate future?

A JOURNEY AROUND LAKE EYRE.[1]

By Professor J. W. Gregory, F.R.S., Glasgow University.

The European settlement of Australia began with the foundation of Sydney in 1788, and for some years the main energies of the colonists were devoted to the fertile plains along the eastern coasts. Early attempts were made to reach the interior; but the way inland was barred by forest-clad cliffs, which for a while proved insurmountable. In 1813 that dread enemy of Australia, drought, fell on the coast plains and forced the colonists to seek fresh pastures beyond the hills that hitherto had hemmed them in upon the west. With this stimulus three explorers, Wentworth, Blaxland and Lawson, forced a way up the cliffs of the Blue Mountains. It was then discovered that the mountain slopes to the west of Sydney were not the front of foothills, hiding yet higher ranges behind. They were the face of a vast rugged tableland, the surface of which falls to the interior and is drained by large rivers flowing directly away from the sea inland. The fate of these rivers became at once the most striking puzzle in Australian geography. The coasts of the continent had already been surveyed, and it was thought that the careful work of Matthew Flinders proved that no great river had its outlet on the southern coast. Hence arose the conception of Australia as a great saucer-shaped continent, with a rim of mountains enclosing a vast central depression.

Oxley in 1815 and 1818 was the first to track the rivers far into the interior, until they expanded into vast swamps, which were passable neither on foot nor by boat. He concluded that he was near the edge

[1] A Lecture delivered before the Society in Edinburgh on March 26, 1908. A fuller account of this journey and its results was published in a work entitled *The Dead Heart of Australia and its Flowing Wells* (Murray: London, 1906), reviewed in the *Scottish Geographical Magazine*, vol. xxiii. p. 19 *et seq.*

of an inland sea, fed by the heavy rains on the mountain girdle of Australia. Oxley's supposed sea, however, proved to be non-existent or only temporary. For Sturt, who followed him during the dry season of 1828, instead of an inland sea found a desert, with streams of salt water and pools of brine. The rivers that flow down the western slopes of New South Wales into the interior join the Murray River; and such of the water as is not returned to the air by evaporation trickles out to the Southern Ocean through the sand-bars of the Coorong in South Australia.

The exploration of the central basin of Australia, which had been begun from Sydney, was prosecuted after 1836 from a new base. The state of South Australia was then established as a social and political experiment. Its capital, Adelaide, was founded a few miles from the shore of the Gulf of Saint Vincent on a plain, which ends abruptly inland at the foot of the Highlands of South Australia. The country around Adelaide was at first disappointing, and the colonists turned their attention northward in the hope that the valley at the head of Spencer Gulf would lead up to a central mountain region with a better rainfall and less arid soil.

The exploration of the valley that runs inland from the head of Spencer Gulf was begun in May 1839 by E. J. Eyre, afterwards famous as Governor of Jamaica. In his first journey he travelled northward from Port Augusta to a mountain subsequently called Mount Eyre, from the summit of which he saw a wide sheet of salt swamps, which he named Lake Torrens. The lake extended further northward than he could see, but appeared to offer an easy route to the interior. So next year he started northward again along the eastern shores of Lake Torrens, to a mountain which he called Mount Deception, whence he saw the lake bending to the north-west. Need of water drove him to the hills, and he kept northward along them until they sank below the plains. Leaving his main party in camp, he continued with only one black boy, until in August 1840 he was stopped on the shore of a dry lake trending from east to west. Eyre thought that this was also part of his Lake Torrens; so he returned to his main camp and started inland toward the north-east. As soon as he left the hills, he was again stopped by the bed of a salt lake, trending first to the east and then to the south. Eyre concluded that the lake shores he had reached all belonged to one great lake, which was shaped like a horse-shoe, and surrounded the South Australian Highlands on all sides except the south. To cross the bed of these salt lakes is often impossible either on foot or by boat. "On every side," said Eyre, "we were hemmed in by a barrier which we could never hope to pass." He named the hill from which he had his best view to the north-east "Mount Hopeless," and returned to Port Augusta intending to resume his journey northward along the western side of the lake. Instead he started on that famous journey around the Great Australian Bight, which is probably the most remarkable feat of travel, and the most dramatic story in the annals of Australian exploration.

The next attempts to gain the interior were made to the east of

Eyre's horse-shoe lake. Sturt in 1844 started from the Darling River and journeyed further north than Eyre. He reached what he called the "Stony Desert," which he regarded as the bed of a northern extension of Lake Torrens. In his efforts to cross it he suffered such hardships that when his graphic journals reached Adelaide they turned his wife's hair white in a single night, and kept men from following in his footsteps for almost twenty years.

A series of less famous expeditions threw further light on the structure of the Great Valley of South Australia; but the results were economically disappointing. The supposed easy route to the interior was found to be a snare. The great valley indeed was there. Its grade was easy. The country on its floor was open. But instead of the expected fertile plains there were wastes of shifting sand, and instead of a river commensurate with the vast area it was supposed to drain, there was only a line of brine pools and salt swamps.

In 1860 it was still believed that most of Central Australia had an unbroken outlet to the Southern Ocean through Eyre's Lake Torrens; but then Babbage made the discovery that the basin of Lake Torrens was closed to the north by a range of hills, and that the northern lake-shore reached by Eyre belonged to an independent lake. Eyre's horse-shoe lake has since been broken up into many lakes, through the gaps between which there are practicable routes to the interior.

The largest of these lakes has been named, after its first discoverer, Lake Eyre; it occupies a lower basin than Lake Torrens, and its shore has been proved to be about thirty-nine feet below sea-level. There are many points of such interest in the geological history of the Lake Eyre basin, that I seized the first opportunity for a few months' field work in Australia to make a visit to this area. I hesitatingly invited my assistant, Mr. H. J. Grayson, and five of my students to go. I was unable to give them a very pressing invitation, as I could not represent the journey as likely to prove an easy picnic; for our work in Melbourne rendered it impossible for us to go except in our summer vacation; and Lake Eyre is never likely to become a fashionable summer retreat. Even travellers of the middle generation of Australian explorers, such as Warburton, scouted the idea of the possibility of travel in the Lake Eyre district in the summer; and the missionaries in the station at Kilalpannina, to the east of Lake Eyre, warned me that the shade temperature at that season often varied from 118° to 125°. But these warnings had little effect on the enthusiastic Melbourne students, and five members of the Engineering School of the University, Messrs. Donaldson, Dow, Lyon, Voss Smith and Guy Smith, promptly accepted the invitation. To their help and comradeship and the invaluable help of Mr. Grayson, most of the success and pleasure of the expedition was due. Our party was made up to nine by the engagement of a camel-driver and a cook. As our journey was being made to one of the hottest areas in Australia and in the summer, I was strongly advised to engage an Afghan camel-driver; but fortunately I decided on a white man, who probably withstood the hard work in the extreme heat better than an Asiatic would have done.

Our party collected at Adelaide, and we started thence (in December 1902) by a railway which extends seven hundred miles northward into the interior. Late on the second day, the train landed us at Hergott Springs, a settlement which has grown up around a group of hot springs. The crowd of Afghans on the platform at once impressed upon us that we had reached one of the chief camel depôts of Australia. Hergott was suffering at the time from a severe heat-wave, during which the record temperature had been almost reached. The hotel was like an oven. Sleep was possible only out on the verandah, whence at daybreak we had our first view of the surrounding country. It looked at first uninviting from its appalling dreariness and desolation. But the sunrise with its swift play of pure vivid colours sweeping across the plains, lighting up the white-walled mosque and the brown huts of the Afghan camp, soon threw an oriental charm over the landscape. As we watched the scene, entranced by the beauty of the colour effects, we all felt the call of the desert: we were eager to start along the rough trail that led out northward across the plain and follow it over some low hills of desert sandstone into the haze-filled basin that lay beyond.

We had not long to wait. Everything was ready for us, and in twenty hours after our arrival we had made our last purchase, our last load was tied, and we had the pleasure of seeing our caravan of nine camels start from the town. We made a short stage that evening, and our first real march was on the next day. It took us on to what are known as the Illusion Plains, on account of the exceptional vividness of the mirage effects. We thought them well named, for we were soon experiencing the usual discomforts of a first march. The camels were frisky, and yet slack after their long rest. The ropes stretched and worked loose, and the loads had several times to be re-tied; and just as the main party reached the halting-place, a blinding dust-storm swept over the plain, turning the camp into confusion, and preparing us to believe the worst that had been written about the interior of Australia. Next day everything was more cheerful: the air has been cooled and cleared by the previous storm; we had an easy march; the loads rode better, and in the evening we reached a lovely camping-ground on the bank of the last freshwater pool we were to see. There were plenty of wild duck for supper, and we saw a few cattle belonging to the last station, except the mission, which we were to see till we came close to the railway at the end of our journey.

Our next march led us on to Sturt's Stony Desert; and this type of desert well deserves its name. There have been many speculations as to the origin of these stony plains. Sturt regarded them as shingle on the bed of a former lake; but they are due to the action of wind and not of water. The whole of this country was once covered by a sheet of rock known as the "Desert Sandstone." This rock has gradually been broken up. Its hard crust and the pebbles in it have been left littered across the country, while all the softer and lighter material has been blown away. The pebbles show the characteristic effects of wind action.

The first stages of our journey were easy, as we followed the well-

known track by which cattle raised on the downs of western Queensland are driven to the South Australian railway at Hergott Springs. The traverse of this country has been rendered possible by a series of deep wells which have been bored by the South Australian Government. Some of them are a mile deep; but the water in the water-bearing layer is under such heavy pressure that as soon as it is tapped it rushes up with great force and overflows at the surface. The flowing well at Dulkaninna discharges about one million gallons a day. Providence knowing that tea was to be the national beverage of Australia, considerately arranged that the water of some of these wells should come up almost boiling, and from that at Kopperamanna I made tea without further heating the water.

As soon as we left this artificially watered stock-route, travel was possible only by the use of camels. During the summer in this hot arid climate, a horse requires three hundred pounds of water a day which is about the full load it can carry. Camels carry so much more and drink so much less, that they are independent of a daily or even weekly water supply. Camels in Australia have gone more than a month without drinking, and Central Australia could never have reached its present stage of development but for camel transport.

Late one evening, after a long march across barren stony plains, we camped at sundown in sight of a dark belt, which next day proved to be the trees on the flood plains of Cooper's Creek. This river will be ever famous in Australian annals, as it was on its banks that Burke and Wills, after accomplishing the first traverse across the continent, perished of starvation during their return journey. Cooper's Creek, where we reached it, was a broad muddy flat eight miles across; the whole width is flooded when the river is running; but at the time of our visit it was only a plain covered with scrub and low trees, and containing a few pools of salt water. On the sandhills on the northern bank stands the mission station of Kilalpannina, where for thirty-five years a party of devoted Lutheran missionaries have been at work educating and helping the surrounding tribes.

The few aborigines still living on the shores of Lake Eyre belong to some of the most primitive tribes in Australia; and it has been claimed that they have the most archaic of existing social systems. The prevalent idea of the Australian aborigines is that they are the most degraded and lowest of mankind. So I expected to find them lower than the African negroes or even lower than the African pygmies. I was accordingly surprised at their high intelligence and generous spirit, and at the striking resemblances in their features to those of Europeans. These facts, however, are easily understood, when it is remembered that the Australian aborigines are probably "black Caucasians," the view advocated by Dr. Russell Wallace. As Caucasians they therefore belong to the same primary division of the human family as ourselves. The extreme hairiness of these Australian aborigines is a character in which they differ from the negroes. Among their striking physical features are the deep notch above the nose and the receding eyes, characters probably acquired by prolonged exposure to the glaring sun of these open sandy plains. In face the

aborigines in many ways resemble Europeans, for though the facial angle is low, they have fine wide foreheads. Among their nearest allies are the Vedda of Ceylon and the Hairy Ainu of Japan, who are other survivors a formerly widespread primitive race of hairy Caucasians.

After a few days' stay at the mission station we were compelled to tear ourselves away from our hospitable hosts and continue our journey to Lake Eyre. We loaded our camels in the afternoon with the mission thermometer standing at 123° in the shade; and we noticed as we loaded our camels, that the blacks, though they said they often had it hotter, kept contentedly in the shade of the nearest verandah.

Here both our difficulties and work began, for we were entering waterless desert and the field of our special inquiries. According to the traditions of the Australian aborigines, the barren deserts of Central Australia were once fertile, well-watered plains. The country was covered by a solid vault of clouds, which were supported by three gigantic gum-trees that towered aloft to support the sky. Great animals, the Kadimakara, lived in the skyland and occasionally climbed down the gum-trees to feed on the luscious vegetation that then grew around Lake Eyre. Once while some of the Kadimakara were below, the gum-trees were destroyed and the animals were cut off from their retreat to the skies. So they had to roam about on earth until they died. Their bones are said still to lie where they fell; and at times when the country is devastated by prolonged drought the aborigines pilgrimage to these places, and there by sacred ceremonies appeal to the spirits of the Kadimakara to intercede with those that still live in the sky and control the clouds and the rain.

It seemed probable that these legends referred to the Diprotodon, a gigantic marsupial which, though now extinct, lived in Australia in times geologically recent. The legends might be a reminiscence by the aborigines of personal acquaintance with these animals. Accordingly we hoped to visit some of these localities, and by finding fossil bones in them, discover what sort of animals the Kadimakara were, and possibly also whether they and man were contemporary in this part of Australia. In spite of the widespread belief that Australians are the most archaic of mankind, Australia is the one continent where there is not yet evidence of the great antiquity of man. In spite of the exceptional thoroughness with which the gravels of many parts of Australia have been searched for gold, and that by keen-eyed miners who are, I think, the most intelligent of all artisans, and who take the liveliest interest in the chance of finding aboriginal implements, yet there are no well-authenticated instances of the discovery of ancient stone implements in Australia. As there is no direct evidence of man having been in existence in Australia for any considerable length of time, it appeared possible that these Kadimakara legends might give indirect evidence. Hence, in addition to our geological work, we hoped to discover new facts of anthropological interest. So we turned aside from the stock route to Queensland to follow Cooper's Creek toward Lake Eyre. As we journeyed westward the aspect of the country changed. The river bed was no longer a vast clay flat, but a

narrow channel between well-defined banks; on the floor of the river channel there appeared a chain of waterholes full of intensely salt water. These pools themselves are shallow. There had been no rain for more than twelve months, and yet evaporation would remove all the water in these pools in the course of a week or two. Hence the presence of the water showed that the supply was renewed by percolation from the surrounding loam hills. Our only chance of being able to work in this district depended upon finding the trickles of fresh water which feed these waterholes.

Sometimes a few rushes or a slight dampness of the ground would indicate an underground channel. By digging pits in such places the water would slowly drain into them. Such holes are known as soaks, and we studied the nature of these soaks, in order that we might discover the most likely places to renew our supplies of water.

After some days' march we reached some large water pools, where Cooper's Creek flows through a deep channel; and here we were told by an aboriginal guide that we were near one of the localities sacred to the Kadimakara. He promised next day to show us where one of these animals lay buried. We started out to search first thing next morning; and soon one of our black fellows became wildly excited, and with many gesticulations he pulled from the ground a jaw of a Diprotodon, exclaiming as he did so "Kadimakara."

Leaving a party to dig at this locality for further specimens, the rest of us went on to Lake Eyre. We found on our journey many other deposits of fossil bones; but as we reached lower country we found increasing difficulty with our water supply. There was plenty of salt water, but none fit to drink. Luckily, however, a stray dingo track led us to a hole among some sandhills, where we found a soak that gave fairly fresh water. It took us so long to refill our water-casks from this slow soak, that we resolved to cross the plateau beyond by a night march. The night at first was perfectly quiet and calm. The air was still, and there was not a rustle of the dry grass tufts; nothing disturbed the silence except the dull thud of the camels' feet and the occasional creak of their harness. Towards midnight we suddenly heard a rustle in the distant scrub by the Cooper. The sound quickly increased into a whistle, and then into a weird yell, and as the sound was rushing towards us, we knew that a storm was about to burst upon us. We had only just time to make the camels sit down and to unfasten their loads, when we were struck by the wind and enveloped in a swirling, stifling cloud of dust. It was impossible to face it, and in the pitchy darkness and buffeting eddies, we lost any sense of direction. All we could do was to wrap our heads in our blankets and crouch beside the camels. The noise was deafening. For an hour and a half we were pelted with coarse grit which had been lifted off the bed of the Cooper. Then in a lull in the storm we found that one of our aborigines was missing; but our shouts guided him back to us. He had been caught by the storm only a few yards away, and found it quite impossible to return to us.

The same storm burst upon the others at Emu Camp. They were

fortunately sheltered in the valley, but when the wind had finished wrestling with the tents they were not worth taking on except as dish-cloths. The men had to struggle up through the sand that rained upon them, and next day many of the loads were buried feet deep in sand and had to be dug out.

After recovery from the storm we pressed on next day down Cooper's Creek and reached its delta. Leaving a black fellow to dig a soak and to collect water for the return journey, we crossed the sand-hills to the shore of Lake Eyre. We got there on a dull grey day, with a low haze covering the plain and heavy clouds covering all the sky. The country was a picture of melancholy. We could see no water in the lake, and went for a "cruise" for some miles on to its bed, which was in places muddy, and we could probably have marched right across the lake to the eastern shore. The journey, however, would have been a waste of time, so we returned up the Cooper and rejoined the rest of our party at Emu Camp.

Here we had to say farewell to most of the aborigines who had come with us from Kilalpannina, and an incident at our parting illustrates their kindly disposition. The demands on our sugar and tea were greater than we had anticipated, and our stock was running low; so on giving the aborigines food for their return journey, I apologised for the smallness of the rations of tea and sugar. Their chief spokesman soon came back to say, that as they were going back to the station where they could soon get whatever they wanted, and we were going out into the desert, they wished to return all the tea and sugar that we had given them. It was fortunately unnecessary for us to avail ourselves of this generous offer, but it is typical of the considerate kindliness of these people.

From Emu Camp we had a march northward for fifty miles across a waterless stretch of country—the Tirari Desert—which we heard would prove difficult. But the march was easy; for our way lay between parallel sand-dunes which cross the country in long lines sometimes as regular as railway embankments. The valleys between the dunes had firm level floors, so we made quick progress. This stage in the journey took us to the valley of the Diamantina River, which rises in the hills of Queensland, and when it contains any water, discharges it into Lake Eyre. At times of exceptional rains in Queensland, the Diamantina is a great river which rushes down on to the Lake Eyre plains as a roaring flood many miles in width. The most probable explanation of the disappearance of the Leichhardt expedition—one of the great mysteries of Australian exploration—is that the whole party were engulfed in one of the floods of this river. At the time of our visit, however, the Diamantina was not flowing. Along its course there were occasional pools of brine maintained by drainage from the sand-hills, and some of them were charmingly picturesque. Most of the river bed was occupied by tracts of dry sand with intervals of soft mud. These mud belts were our chief danger; for camels smelling the moisture from the mud flats are tempted on to them and "bogged." One of our camels had this misadventure, and we lost half a day in

the arduous work of digging it free and hauling it on to a platform of faggots.

After a series of long marches down the Diamantina we left it, and crossed a plateau to the valley of a river that sometimes enters Lake Eyre from the north-west. We hoped to find guides across this country in a camp of aborigines; but the few black fellows fled at the sight of us, and we had to find our way for ourselves. A worse disappointment was that the water in the pools, which we hoped to find only brackish, was too salt even for the camels. As the water was fit neither for man nor beast, we had to camp till we could find soaks and collect a store of water for the journey ahead.

Having obtained enough to give each camel a full drink, and having filled every water-holding vessel in our equipment, we left the Diamantina and climbed on to the plateau. The following marches were the most arduous of the expedition. The sandhills were high, and as they lay in parallel lines right across our line of march, we had to climb them one after the other; in one day we crossed thirty-three. Some of the hills were so steep that the whip had to be brought into play to lash the camels over the last caps of sand on the crests. By steady pressure and careful driving, we crossed the country, and reached the delta of the Macumba river, which, on the rare occasions when it flows, enters the northern end of Lake Eyre. We had hoped for water here; but as the ground was saturated with salt, there was no hope of finding fresh water, until we rose above the plane of salt saturation. It was absolutely necessary to get water before we left this valley, as we had before us a long march over a plateau, where there would be no water, to a valley where there might be none. So we continued anxiously up the Macumba valley till we reached a part of it where fresh water became possible. For a while the search was vain, and after dark we continued our march up the valley. At length to my great relief I saw in the distance the flare of a fire which told us that one of our party had found water. I rushed on to the signal, thinking that if the quantity of water was proportionate to the size of the signal fire, our difficulties were at an end. But it was only an old soak, which had been dug and abandoned by the aborigines. The water was so salt and the supply so scanty that our camel-driver when he came up reported that it was useless. The quantity might keep one man from starving, but was no good to us, let alone to our camels. However, by the firelight we settled down to study the conditions, and found that though most of the water trickling into this soak was salt, from one layer it was fresh enough for us to drink when made into tea, and also for the camels. So we plastered up the salt-yielding layers, and opening several soaks, carefully collected the fresher water; we baled it into improvised canvas troughs for the camels. Half our party were kept busy guarding them as they were making desperate efforts to get to the salt-water pools, in the muddy borders of which they would have been inevitably bogged. By patient work all night we obtained enough to give each camel a five-gallon drink, and had a sufficient store for ourselves to risk the march across the plateau ahead. We crossed it safely, and as we had left the country where there was

any chance of finding "Kadimakara" bones, we pressed on quickly towards the railway which passes some distance to the west of Lake Eyre. We reached Wood-duck station, but it was abandoned as the local water supply had failed. We rested in its shade till the evening, hoping to make a long night march. But we were stopped by the bed of the River Neale, which was too wide and muddy for us to risk its passage in the dark. We crossed its muddy bed at dawn, and by the next march arrived at the hills on the western border of the Lake Eyre basin. At their eastern foot is the only cattle station then occupied in the district, "the Peake," where we had a most hospitable welcome from the proprietor.

The aborigines at the station were performing a five-night corrorobee, and they gave us permission to attend the last performance, which was to be held that night a few miles from the station. Mr. Grayson kindly took on the baggage camels, leaving us to follow after dark, for the train was going next day, and it only goes once a fortnight. We attended the first part of the corrorobee, and marched across the hills after midnight. At first we had a little moonlight, and the journey was easy, but after the moon had sunk, it was so dark that we could see nothing. Guided by the compass we kept on westward until suddenly we stumbled across a railway line, which seemed singularly out of place in such a desert. Following the track we reached the station in time to catch the fortnightly train, all glad that we had got our collections back in safety, but sorry that our six hundred mile camel-ride had come to an end.

This regret may seem unreal, for it is difficult to describe such a journey without giving the impression that the work was tedious and arduous, but the discomforts of our journey were really trivial compared with its pleasures, for the desert has a charm as irresistible as it is almost indescribable. It is easy to state the discomforts of our journey, but the attractions of the desert are matters of sympathy that must be felt. The desert has a wonderful beauty of its own. The colours that sweep across the plains at sunrise and sunset are of unrivalled brilliancy and purity; and the breadth of the scenery, with its free open curves, its long low horizons and its unequalled expanse of sky, gives an exhilarating sense of freedom.

It is true that in the heat of the day the desert is often harsh and hard. Such is the mood represented by the poets—

> "When the sun burns as a menace,
> Glaring from a sky of brass,"

and according to Kendal, the nature poet of Australia—

> "On the tracts of thirst and furnace, on the dumb, blind burning plain
> When the red earth gapes for moisture, and the wan leaves hiss for rain."

But then after the struggle and the glare of the day, follow the perfect peace, the exquisite silence and soft beauty of the night. The contrast inevitably suggests that between life and death, and it presents the two chief associations of death in their most attractive guise. The desert

thus projects the imagination into the future, while at the same time it recalls the instincts of the past; for the simplicity of desert life, the persistent uniformity of its conditions, and the merciless severity of its forces, all awaken the feelings of early man. The traveller with a small caravan in the desert meets the conditions of prehistoric man, but he regards them with the thoughts of the twentieth century. And to face mystery and the unknown free from the fears that paralysed primitive people, gives that stimulus to the imagination which is the highest joy man can know.

I have, therefore, tried in this lecture not only to give some account of the present conditions and to show photographs of the scenery of the vast plains of central Australia, but to hint why the Australian bushman loves that country so dearly; for though in general accounts of travel there, the discomforts loom large, they are really insignificant compared with the deeper and more lasting impressions for which we shall always remember with gratitude our sojourn in the desert places round Lake Eyre.

THE RIVER MASSAN.

By Frederick Mort, M.A., B.Sc., F.G.S.

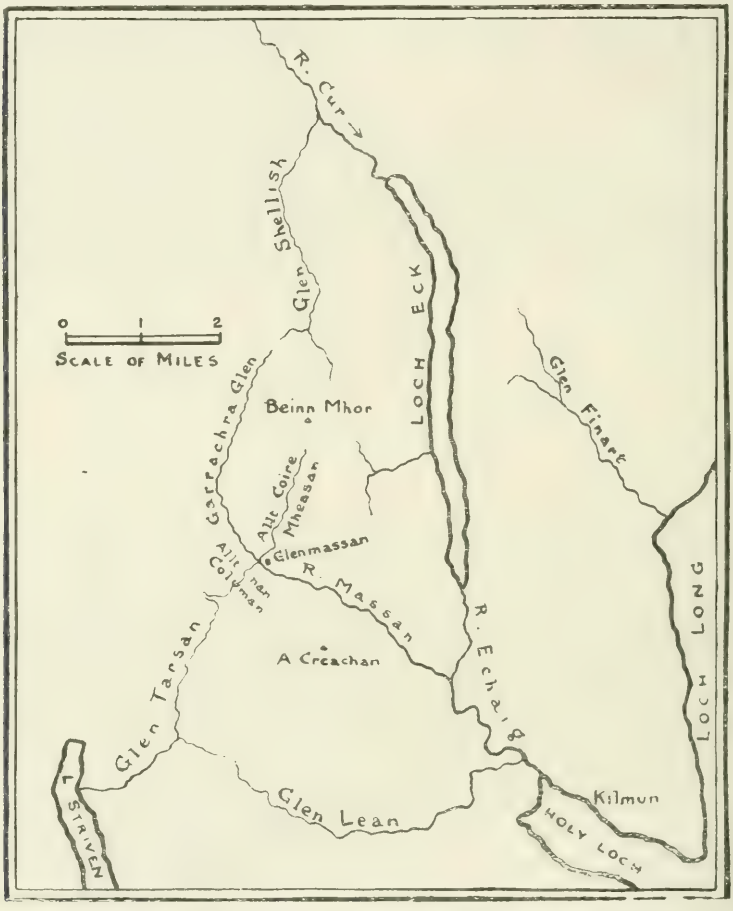
(*With Sketch-Map and Section.*)

The district of Cowal, comprising the Highland area between Loch Long and Loch Fyne, presents numerous interesting problems in river development. Many of the streams illustrate nearly all the typical features of river-erosion in the most beautiful manner and for this alone are worthy of detailed study. In addition, their past history will have to be thoroughly investigated before the present drainage system of Scotland is properly understood, for in this district evidence must be looked for connecting the present rivers of the Southern Uplands with their former head-waters which, it is supposed, may have arisen even west of the present coast-line of Scotland.

In dealing with the River Massan a brief account will first be given of typical examples of river-work well illustrated by this stream; and secondly, some consideration must be given, necessarily more speculative in character, to the former history of the Massan and its relations to neighbouring streams. Pupils in schools or students in colleges might well spend a whole day in tracing such a stream from mouth to source. Such an excursion, under competent guidance, would be of great educative value, and it is to be hoped that at no long distant time such practical study will be an integral part of the geography curriculum of every school and college.

The Massan is represented in maps and is generally thought of as a tributary of the Echaig which flows into the head of the Holy Loch. A glance at a map, however, will show that the Holy Loch was not formed by the Echaig but by the Massan, for the loch and Glen Massan are in one straight line. A person in a boat about the middle

of the loch can see a long way up Glen Massan, while the Echaig glen is invisible, as it bends off almost at once towards the north. If we neglect the sizes of the rivers, then the Massan is the main and the Echaig the tributary. Below the confluence of the two streams the combined Massan-Echaig flows gently towards the sea in a beautiful series of swinging meanders over the old raised beach. From the

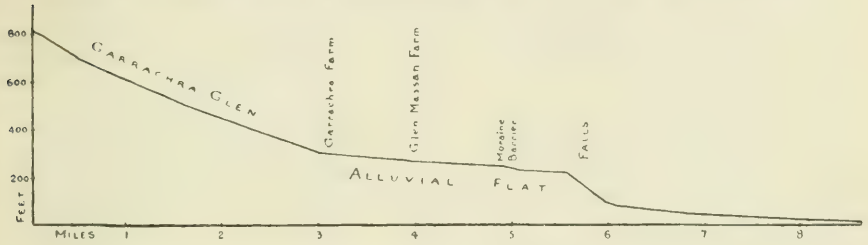


Sketch-map showing the relation of the Massan to neighbouring streams.

junction to the falls, a distance of about two miles, the Massan is cutting a young channel through morainic material and alluvium spread over the flat floor of the old valley. The channel is from 6 to 15 feet deep and but a few yards across. Like so many other rivers in Scotland, the stream here seems absurdly small for the great valley in which it flows, on the bottom of which the present channel excavated since glacial times seems a mere trench. An explanation of this will be suggested later.

The falls of the Massan are not large, but in many ways are strikingly beautiful. They are worth a visit if for nothing more than the splendid examples they present of corrasion by means of pot-holing. In one place the rock is continuous from one side to the other and the stream flows beneath a complete natural arch. A small slip has piled up great masses of rock in tumultuous confusion in the stream channel, adding considerably to the wildness of the scene. The falls have been caused by the occurrence at this point of a hard band of schistose grit with much quartz, the foliation planes of which strike directly across the stream. The softer rocks below have been eroded more rapidly than this band, and in this way a series of falls has been produced. About this point a large quantity of morainic material has been deposited in the valley and good sections of it are to be seen at the roadside below the falls.

Whenever a waterfall is found in a stream, one may look with confidence for a broad alluvial flat above it. This is well shown in Glen Massan, the valley opening out above the falls in a most striking manner



The Massan from its source to a point two miles from the Sea.

into a broad alluvial flat of great extent and consisting partly of well-bedded deposits of fine sand. The stream has been unable to corrade its channel below the level of the falls, and the available energy has therefore been utilised in lateral corrasion. Consequently we find the course of the Massan falling into two natural divisions, one from the source to the falls, the other from the falls to the sea. This is well shown by the accompanying section which exhibits two typical curves of river-erosion, a temporary base-line having been established in the part of the stream above the falls.

The alluvial flat stretches upstream above the falls for over two miles. It is divided into two by a deposit of moraine-stuff through which the stream is cutting and in which it has exposed a fine section of boulder-clay, from ten to thirty feet high. The stream here flows fairly rapidly, the increased slope being just perceptible in the section. Above this point occur some pretty examples of old river-terraces. In addition to the present fairly broad river-flat, two older terraces are shown quite distinctly.

Towards the head of this flat near the farmhouse of Glen Massan, two tributaries join the main stream practically at the same point, the Allt Coire Mheasan on the left bank, and on the right bank the Allt nan

Columan, not named on the one-inch ordnance map. The relation of these streams to their main will be referred to later. Above the farm-house of Garrachra the valley narrows again, and from this point to the source is called Garrachra Glen. The straightness of this glen is probably due, not only to the fact that it runs along the strike of the rocks but also to a line of fault which coincides for some distance with the direction of the stream. The former fact is also the cause of the asymmetry of the valley in cross-section. The east slope is smooth and grassy and not nearly so steep as the west, which presents a series of rocky cliffs. The foliation planes dip to the west, thus giving rise to a typical case of crag and dip-slope. The invariable tendency for a fall or rapid to be accompanied by a flat plain above is shown in this glen in an interesting way, where a recent rock-slip has partially dammed the stream. Above it can just be detected a tiny alluvial flat due to lateral corrasion working for a comparatively short time.

When the head-waters of the Massan are reached at the top of Garrachra Glen, it is obvious that we have to deal with abnormal conditions. The stream rises in a broad, marshy flat, and a walk of 150 yards farther brings one to the head of the Shellish, which flows in the opposite direction. The divide between the two streams is imperceptible. Yet though we have reached the head of the river, the valley in which it flows continues unchanged. On each side the ground rises for hundreds of feet above the broad, flat floor of a mature valley that is quite continuous from the Massan to the Shellish. Glen Shellish and Glen Garrachra are not two glens but one, and the conclusion is forced on the observer that a single river must have flowed in the valley now occupied by the two streams mentioned.

So far there can be little difference of opinion. In suggesting the former history of the original un-beheaded stream we enter less sure ground. The river must have flowed either north or south, and a good many considerations prevent us from thinking the former. It is suggested, therefore, that the river Cur, which now drains into Loch Eck, originally flowed along Glen Shellish and Garrachra Glen. The Finart, working backwards, was able to capture the head-waters of the Cur, for its gradient was steeper, since it reached the sea in 8 miles, while by the present course of the Massan the distance from the sea is about 14 miles. The valley thus cut off then naturally drained in two directions, one part being occupied by the present Shellish, the other by the present Massan. The abnormal direction of the Shellish is now clear; at the present time for most of its course it is running almost exactly opposite to the direction of its main river. The later history of the Finart has been told by Cadell (*Scot. Geog. Mag.*, vol. ii.). The Echaig working backwards, beheaded it and gave rise to the wind-gap between Whistlefield and Ardentinny. That this was a later event is indicated also by the fact that this gap is just over 600 feet above sea-level, while the gap between Glen Shellish and Garrachra Glen is a little more than 800 feet above the level of the sea.

A similar problem is encountered when the Allt nan Columan is considered. As already mentioned, it joins the Massan just opposite

another tributary, the Allt Coire Mheasan. The valley in which the Allt nan Columan flows is really a part of Glen Tarsan, which runs into Loch Striven and grooves deeply right through the ridge between this loch and the Massan. That this broad valley was eroded by one river, no one who has walked through it can doubt. The Allt nan Columan is an interloper, its trickling head-waters six inches wide forming almost a ridiculous contrast to the splendid glen which it pretends to have excavated. On the broad floor of this glen lower down, the stream flows in its own valley, a narrow, deep, V-shaped trench with all the characters of youth. We have obviously here another case of beheading. The fact that Glen Tarsan is quite continuous with the Allt Coire Mheasan can hardly be a coincidence. This latter stream originally flowed into Glen Tarsan until cut off by the Massan. In fact the great size of the wind-gap into Glen Tarsan makes one wonder if Garrachra Glen and Glen Tarsan were not once continuous. The Massan has been able to capture these head-waters by reason of its greater gradient. It reaches the 200-feet contour-line in two miles, while the Tarsan stream takes four miles to reach that level. The strike direction of the foliation seems to have had little effect on the rate of excavation at this point. The foliation planes can be seen over and over again, lying quite flat in the bed of the Allt nan Columan.

The foregoing paper has been confined to the Massan and its tributaries, but similar problems await examination in other parts of Cowal. The district is one full of instructive lessons for the most elementary student of physical geography, and in addition presents many difficult and interesting studies for the most expert investigator.

EARTH AND MAN: A REVIEW.[1]

No apter illustration of the width of outlook demanded of the geographer could be found than in Elisée Reclus' last great work. It is at once a work of history and a work of geography, and puts the somewhat ambiguous subject of historical geography into its true place: in the present instance it must be judged rather from its geographical standpoint, but certainly it could, with equal justification, be looked at from an historian's point of view. *L'Homme et la Terre* was a fitting culmination to the life labours of this greatest of synthetic geographers, and takes its place as a unique work, surveying the progress of man from a standpoint from which few writers have looked before, and perhaps none with so all-embracing a vision.

Here the whole story of man's progress, from his earliest beginnings to the dawn of our own era, is traced; step by step the tale is unfolded from the earliest civilisations of the Euphrates basin to the eighteenth century. Man is not treated as an abstraction apart from his environment; his struggles and his progress, his wars and his alliances, his religions and his discoveries are all interpreted in terms of his changing

[1] *L'Homme et la Terre*. By Elisée Reclus. 4 volumes. Paris: Librairie Universelle, 1908. Price 20 frs. each volume.

environment. Reclus has given us an exposition of the scientific treatment of history, as different from the dreary, unmeaning chant of wars and kings, as his great *Géographie Universelle* is different from the unliving catalogue of uncorrelated facts which the passing generation knew as geography.

It is a lucid and very stimulating suggestion of Reclus' that history and geography differ but in being outlooks on the relations of man and place, the first in the dimension of time, the second in the dimension of space. "La Géographie n'est autre chose que l' Histoire dans l' Espace, de même que l' Histoire est la Géographie dans le Temps." That postulate appears on each volume, and in it lies the keynote to the work before us. No doubt that idea implies a broader conception of geography than some students of the science would be willing to admit, and perhaps a narrower one too, in some respects. It lifts geography at once from a mere descriptive art into a rational deductive science, but it also insists that the study of the phenomena of the earth apart from their relationships to man is not geography. That science, as a whole, becomes synonymous with what is often called human geography or anthropo-geography. That is the view taken by many students of the science, yet there are those who would make the more purely physical side of geography the major aspect and restrict anthropo-geography to a study of the distribution of the races of man. The latter term admits of a very wide interpretation but has become very narrowed in usage. It could obviously embrace all other aspects of the science, regional, commercial, economic and historical. Of course it may be said that this conception of geography excludes the consideration of the distributions of animals and plants in their inter-relationships with physical phenomena; but it is after all only a question of terminology whether we apply the terms zoological and botanical geography to these branches of the subject, or whether we include under the heading of geography the study of the distribution of all living things, and then subdivide the science into human, zoological, and botanical branches. Reclus favours the former conception; and surely, since zoological and botanical geography are necessary for the complete study of the distribution of man in his physical and organic setting, human geography should be on a higher plane than these tributary branches. Physical geography, in as far as it deals with the relations of land forms and terrestrial phenomena to man and his work, is also tributary to anthropo-geography. Otherwise it is not truly geography, but rather an aspect of geology. There is a tendency among some geographers to develop this purely physical side of their science at the expense of true geography. That is, no doubt, the inevitable result of the basis of geography being broadened as its place among the sciences is becoming understood. Although Reclus has passed away, no country can now claim more brilliant exponents of geographical science than France, whether in such men as Schrader and Vidal de la Blache, or in the rising generation of geographers who are producing these excellent monographs on the regional geography of various parts of their country of which a number have now appeared.

Fully half of the first of the four large volumes of this work is occupied with an analysis of the factors which go to make up the geographical *milieu*, and a discussion of the extent to which each influences man individually and socially. It may require, the author remarks, an effort of abstraction to study these factors separately, but analysis is essential before a synthetic outlook can be attained. From some notes on the origin of man, Reclus passes to a lucid exposition of the action of physical and organic environment on man, in affecting his progress and determining his occupations; and thence he passes to the relations of man to man in elemental, family, social and national life. Here we have Reclus at his best often expounding the principles of sociology but always illustrating his ideas by reference to material facts: he never passes to the abstract without quickly returning to the concrete. The work is not overburdened with detail, and that fact, to our mind, only enhances its value. The reader can easily collect additional facts and details illustrative of every epoch and race: the undue burdening of the text with these would only tend to obscure the main thesis. The connecting and harmonising ideas in man's story, which Reclus was pre-eminently qualified to give, are those aspects of the science which the analytic student is liable to lose sight of in a mass of detail. Reclus' conception of the story of man and his progress as a coherent orderly whole is that which gives his work its greatest value.

To really understand a race and to interpret its history one must understand its surroundings, not merely at the time, but from the beginning, and its ancestry also. "L'histoire de l'humanité, dans son ensemble et dans ses parties, ne peut donc s'expliquer que par l'addition des milieux avec 'intérêts composés' pendant la succession des siècles; mais pour bien comprendre l'évolution qui s'est accomplie, il faut apprécier aussi dans quelle mesure les milieux ont eux-mêmes évolué, par le fait de la transformation générale, et modifié leur action en conséquence." The physical features of the country, except for small changes due to wear and tear, remain essentially the same through long epochs, but they have different values in one age and in another in their influence on man. "Thus," says Reclus, "the contours of Greece remained identical . . . but what a different significance they had when the march of civilisation spread towards Greece from Cyprus, Phœnicia and Egypt, and when, later, the centre of gravity of history was transferred to Rome." And not only that, but the people change also. Every grade in upward progress is built upon earlier grades and includes survivals of each, all, however, uniting into a new whole different to any that has gone before it. The same combination of forces can never come into operation twice, apart from the fact that the human factor is always changing. It needs, in fact, but little reflection to see why history can never repeat itself.

It has been suggested that sociology and geography are but converse sides of one shield; that the sociologist looks at man with nature as his background, while the geographer starts with nature and studies its influence on man. There is truth in this comparison, but not the whole

truth. It tends to leave no place for the study of the eternal interaction of nature on man and man on nature, which can scarcely be separated from one another. And sharply to divide these two cognate sciences would be to do injustice to both: their grounds must overlap, and though the starting points are different and the approaches are not the same, yet geographer and sociologist have in the end a common meeting-place. As each science in itself is synthetic, so the two form ultimately a large synthesis. From that plane Elisée Reclus is singularly competent to expound his theses. "C' est de l' homme que naît la volonté créatrice qui construit et reconstruit le monde": knowing the man in Reclus apart from the geographer we can understand how deeply this belief is rooted in him. It is primarily in man that Reclus looks for the directive force that is responsible for change in the world. He is a strong believer in the value of the individual. But at the same time he fully recognises the moulding influence of the geographical *milieux*, so that he comes nearer to a reconciliation of these two diametrically opposed points of view than any other geographer has succeeded in doing.

It is a commonplace of geography that environment determines occupation. A steppe country will support a race of nomadic herdsmen, while the farmer is the product of a rich alluvial soil no less than the intractable hunter is the inevitable occupant of lands where game abounds, whether they be dense tropical forests or barren polar wastes. We have long been familiar with the theory, due to Condorcet, that from the primal occupation of hunter man progressed by successive stages through shepherd to agriculturist, climbing, as he went, the scale of progress, modifying his bestial attributes, subduing his passions and developing his mental powers. That was the theory of a sociologist and one which, for long, has met with wide acceptance. In general terms it is undeniable that Condorcet indicated the broad lines of the evolution of man, but a closer examination of the question makes it necessary to modify somewhat his generalisations. Hunting was without doubt a primal inheritance of man from his simian ancestors; the whole human race, even its highest members, shows such tendencies and a liability to revert to the hunter's life, given only the necessary game. A most striking example of this is the case of the hardy race of trappers in the far north and north-west of America who were mainly descendants of an agricultural and pastoral people, but who were rapidly transformed by the forests and game of the north into unrivalled hunters. The probability is that Condorcet's primal epoch in man's upward evolution had little or no existence in the case of those people who, early in their history, found themselves in rich agricultural lands. They might hunt, but they would learn to sow and reap at the same time, nor have we any evidence that even the most primitive races of hunters are better constituted for a meat than for a vegetable diet.

The truth is that, in all probability, the three fundamental occupations of hunter, shepherd and agriculturist date from the beginning, each dependent for its existence on the possibilities of the environment. The pastoral life, for instance, cannot be followed where beasts of domestic value are wanting: the plains of North America have known

no herdsmen, but passed from the *régime* of the hunter to that of the farmer after a bitter struggle for mastery (and for very existence) on the part of the Indians. But certainly those countries which are unsuitable for the higher development of man will never allow their inhabitants to pass a certain stage of civilisation. Take the case of the hunter: his occupation is prompted by passion at root, and consequently it is impossible for him to reach the moral level of the peasant whose work depends on patience and care. A hunting community, moreover, has little permanence and practically no leisure, and for that reason alone cannot develop a civilisation. The same, though to a lesser extent, is true of a pastoral people: they have opportunity for intellectual development, but with no permanent abode, arts and industries cannot arise. We may find much to admire in the social life and civilisation of the nomadic Arabs, but we cannot place them on a level with the agricultural Egyptians or with the natives of India; nor does a comparison between the wandering Tuaregs of the Sahara and the settled Kabyles of Morocco favour the former; in race they are closely allied but in occupation widely separated. Here, moreover, we see how impossible it is to assign this or that attribute to any race, unless in the most general terms. Tuaregs and Kabyles are both members of the Berber race, but the first wandered into a desert region which forced them to adopt a nomadic life, while the second reached a fertile land which compelled them to become tillers of the soil. In fact there are few communities in which one cannot find, at least both hunters and fishermen, and generally peasants too. Into considerations such as these Reclus enters fully with the weight of his years of study and of his personal acquaintance with many lands and peoples.

To pass from the introductory chapters to the main substance of the work, space will permit us to do little more than indicate the author's mode of treatment. The ideal method of writing the story of man's progress—as apart from a catalogue of his vanities and squabbles—would be no doubt to look, as it were, from a bird's-eye point of view on the whole changing drama of each civilisation, and to let one's outlook be limited only by the natural frontiers of that movement. To do this would be relatively simpler in the case of the earlier and less expansive civilisations. It is quite possible to take a comprehensive and yet intelligible view of the earlier "potamic" civilisations; Egypt, Assyria, and Babylonia, for example, were each bounded by the river basins in which they developed, and their influence was scarcely felt beyond. But successive civilisations have spread over an increasingly wide area. The story of man in Grecian or in Roman times is widening immensely in space compared to that of more remote eras. And when we reach modern times—in general terms our "western" civilisation—the ideal method of viewing history must perforce be abandoned. The limitations of our mental vision (not to speak of mechanical difficulties in presentment) deny us the advantage of seeing more than a restricted extent at one time. But Reclus is too discerning a geographer and historian to fall into the common error of making artificial boundaries to his periods and so enhancing the difficulties of mental grasp. The

least rational and most widely employed divisions are those conforming with the political frontiers of to-day. The disadvantage and futility of such chapters need not be dwelt upon any more than the obvious ease in compilation which prompts the smaller mind to use the smaller vision. Reclus remembers that he is writing from a scientific standpoint, and never employs political frontiers as the limits to his chapters, unless so far as they may coincide with race; and so we have the advantage of looking at all contemporaneous aspects of a civilisation at the same time. For instance, his Modern History—the last one and a half volumes—is divided as follows; Christians, Barbarians; The second Rome; Arabs and Berbers; Carlovingians and Normans; Knights and Crusaders; *Communes*; Monarchies; Mongols; Turks and Chinese; The discovery of the World; The Renaissance; The Reformation; Colonies; *Le Roi Soleil*; The Eighteenth Century. These are real periods in the story of man, and the reader's view is not obscured but clarified by such division of the subject.

The work is excellently illustrated. Every illustration has evidently been selected with care, and not a few have high artistic merit. And the liberal use of sketch maps, scattered throughout the text, is very illuminating: there is scarcely a subject discussed or a region treated of which a map is not given. There are maps to elucidate such varied topics as the wanderings of the children of Israel and the cities of the Phœnicians and Greeks; the languages of India and the Western Isles of Scotland; the voyages of Columbus and the universities of Europe; the clothing of African aborigines and the twelve hypothetical locations of the Garden of Eden. In addition there are a number of large coloured maps.

R. N. Rudmose Brown.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

At a meeting of Council, held on the 28th May, the following gentlemen were elected members of the Society :—

Lieut. D. Hay Thorburn. Francis William Hardie.
A. H. Millar, F.S.A. (Scot.). William G. Smith, L.F.

The Council also conferred the Ordinary Diploma of Fellowship on J. G. Ferrier, Secretary of the Scottish National Antarctic Expedition.

The Society's New Rooms.—The rooms at present occupied by the Society being required for the extension of the National Portrait Gallery, the Society will remove at the end of July to the Synod Hall, Castle Terrace. The new rooms occupy the whole front of the building on the first floor, and afford nearly twice the accommodation of the present rooms, besides being in a more central position of the town. This extra space will be of great value for the arrangement of the Society's rapidly increasing Library and Map Collections, whilst the immediate proximity of the Rooms to the Lecture Hall will be a great convenience at the Society's Meetings.

GEOGRAPHICAL NOTES.

Africa.

The Niger-Lake Chad Boundary.—The work of fixing the boundary along the thousand miles of Anglo-French frontier between the Niger and Lake Chad, on the lines of the agreement entered into by the British and French Governments, and ratified in 1906, has been completed, the British Commission having recently returned to England. Major O'Shee, R.E., the British Commissioner, who was assisted by Major Simonds, R.A., Lieutenant Hearson, R.E., Dr. Flood, medical officer, and four non-commissioned officers, left Lake Chad at the end of February on the completion of their eighteen months' work. At that time the French Commissioners were continuing geographical research on their side of the frontier. A complete line of beacons has now been established along the entire frontier, a total number of 148 having been erected, each numbered and marked by tricolour tablets. Some of these beacons consist of stone pyramids 8 feet high, and in other cases where stone was not available telegraph poles have served to mark the frontier. Demarcation began at Ilo, on the Niger, at which place the British Commission, with an escort of fifty troops, commenced work in December, 1906. The French Commission was somewhat delayed owing to an outbreak of yellow fever, but met Major O'Shee and his staff in January of last year, since which time the two Commissions have worked together.

The attitude of the tribes along the frontier was quite peaceful. A portion of the frontier runs through thickly-populated country, and for hundreds of miles it goes through a dense corn-field. Everywhere the Commissioners were received by the natives with great cordiality, and there was no trouble even with the Tebus or Tuareg. There are a few robber bands of the former tribe, but the French have got the country on their side of the boundary into such excellent order that these people cause but little trouble. The Commissioners report that Lake Chad has become more shallow than ever. The last "rainy season" lasted for only one day, and the lake is fast drying up.

Australasia.

German South Sea Expedition.—A scientific expedition to the South Seas left Hamburg, on May 16, on board the steamship *Peiho*, a vessel of 900 tons, which has been specially chartered for the cruise from the Hamburg-American Line. The expedition has been organised by the trustees of the scientific foundations of the city of Hamburg, and its mission is to complete the exploration more particularly of the German islands in the South Seas, and to collect materials for the study of the natives and natural resources of those regions. Professor Fülleborn, a well-known African traveller and for many years assistant at the Hamburg Institute for Tropical Diseases, is in charge of the expedition, and he is accompanied by a competent staff of assistants. The

Peiho reached Hong-kong during June, and will make the Bismarck Archipelago the starting-point for its two years' cruise in the South Seas.

Volcanic Eruption in the Pacific.—According to a despatch from Auckland, dated June 15, a remarkable volcanic outburst began in the Island of Savaii, in the Samoan group, on May 10. The flow of lava was the greatest in the history of the island. It amounted to between two thousand and three thousand tons a minute, and streamed down in a great river from 6 in. to 6 ft. deep, stretching in an almost continuous sheet over a width of eight miles. On reaching the coast it flowed over the cliffs into the sea, causing steam to rise in immense quantities. The lava destroyed many native houses, and for a time threatened the town of Matatua; but at the time of the despatch of the news that place was considered safe.

Polar.

The Scottish National Antarctic Expedition.—Attention may be drawn here to the exhibit illustrating the scientific results of the voyage of the *Scotia* which finds a place in the Industrial Hall of the Edinburgh Exhibition. A similar exhibit is also to be found in the science section of the Franco-Scottish Exhibition in London.

General.

The Congress of Americanists.—We have received a detailed programme of the Sixteenth International Congress of Americanists, which is to be held at Vienna from Wednesday, September 9, to Monday, September 14. The main subjects to be discussed at the Congress are:—(1) The aboriginal races of America, their origin, distribution, history, physical characteristics, languages, customs and religions; (2) The monuments and the archæology of America; (3) The history of the discovery and occupation of the New World. A considerable number of papers dealing with these subjects have been already notified to the Organising Committee, and a provisional list is included in the programme. The languages of the Congress, as on previous occasions, are German, English, French, Italian, and Spanish. The Congress may be attended either by members or associates. Members, who receive the publications of the Congress, pay 20 crowns (4 dollars, 17 marks), while associates, who have no voting powers, and do not receive the publications, pay only 5 crowns (1 dollar, 4 marks). Subscriptions should be paid to Herr Dr. Karl Ausserer, Vienna, Austria, viii /1 Lenaugasse 2, the Treasurer, while the Secretary, Herr Regierungsrat Franz Heger, Vienna, Austria, i. Burgring 7, will answer any inquiries. The programme contains also an account of the excursions of the Congress, which are of an elaborate and interesting nature. They fall into three sections, and each section may be joined separately. The first includes a journey to Budapest, with a sojourn of two days there; the

second a trip to Lake Balaton and its vicinity, with visits to various points of interest; while the third, which lasts for a week, involves visits to Bosnia, Herzegovina, and Dalmatia, with many interesting trips *en route*. Persons desiring to take part in any or all of the excursions should give notice to this effect by September 1 at latest.

Forms of Sub-Oceanic Relief.—The *Bollettino della Geografica Italiana* for March has a note on the terminology of the forms of sub-oceanic relief, by Professor G. Ricchieri, being the results of the labours of a committee appointed by the International Geographical Congress in Venice to fix the Italian terminology. In the suggestions which they have made the members of the Committee have been guided by the principle that the terminology should be *morphographic* and not *morphogenetic*—should be founded, that is, on the actual form, and not suggest the cause.

They divide the slope of the ocean bed into three parts—firstly, that part which is between the tides, and this is termed *Spiaggia*, corresponding to the German *Strand*. The second is the gentle slope stretching to the point where the continental shelf ends. This point may be at 40 or even 500 metres depth, and is termed *piattaforma*, in correspondence with the German *Schelf*, English *shelf*, French *socle* or *plateau continental*. The third comprises the steeper slope beyond the limit of the shelf, and is called *Scarpa*, *Kontinentalböschung* or *Kontinentalabhang* of the Germans. The three zones together are the *Zoccolo continentale*, in German *Kontinentalrand*.

The larger concave formations are divided into three :—

(1) The sub-circular are called *Bacini*, corresponding to *Becken* in German, *Basins* in English, *Bassins* in French. (2) Elongated and wide. —Italian *Avvallamenti*, *Mulden* German, *Troughs* English, *Vallées* French. (3) Elongated and narrow.—*Fosse* Italian, *Gräben* German, *Trenches* English, *Ravins* French, always adding the qualifying term *subaqueous*. These great cavities are further arranged in two divisions—(*a*) Entrances semicircular or triangular.—Italian *Insenature*, *Buchten* German, *Embayments* English, *Golfes* French. (*b*) Entrances elongated and narrow.—*Valloni* Italian, *Rinnen* German, *Gullies* English, *Golfes* French.

The larger rising ground formations are divided into four :—(1) Wide plateau with gently sloping sides and of elongated horizontal form, such as occupies the middle line of the Atlantic.—*Dorsale* in Italian. (2) With gently sloping sides, and subcircular form.—*Gobba* in Italian. These two terms are represented in German by *Schwelle*, English *Rise*, French *Seuil*. (3) Plateau with steep slopes and of elongated horizontal form.—*Dosso* in Italian, *Rücken* German, *Ridge* English, *Crête* French. (4) Steep slope with polygonal or subcircular contour.—*Altipiano* in Italian corresponding in all the international languages with the term *Plateau*.

Minor formations.—The Italian Committee, after much discussion, resolved to adhere to the terminology appointed by the International Congress :—*Creste* in Italian, *Rücken* German, *Ridges* English, *Crêtes* French,—elongated prominences with steep sides. *Cupole* in Italian,

Kuppen German, *Domes* English, *Dômes* French—isolated eminences whose summits are 200 metres below sea-level. *Banchi* in Italian, *Bänke* German, *Banks* English, *Bancs* French—similar eminences whose summits are between 200 and 11 metres from the surface. *Secche* or *Scogli*, *Gründe* and *Riffen* German, *Shoals* and *Reefs* English, *Hauts fonds* and *Récifs* French, according as they are formed of sand or hard rock, if they are at less than 11 metres from the surface.

Smaller concave formations.—(1) Cavity more or less subcircular—*Buca* in Italian, *Kessel* German, *Caldrons* English, *Caldeiras* French. (2) Cavity elongated—*Solco* in Italian, *Furchen* German, *Furrows* English, *Sillons* French.

In connection with these terms reference should be made to the suggestions put forward by the Committee of the Sixth International Congress (cf. *S.G.M.*, xix., p. 425).

EDUCATIONAL.

Mr. R. N. Rudmose Brown, B.Sc., has been appointed to the new Lecturership in Geography in Sheffield University. It will be remembered that Mr. Brown was a member of the Scottish National Antarctic Expedition, and was also appointed in 1906 Special Commissioner to study the pearl oyster fisheries of the Mergui Archipelago. Mr. Brown has published articles in the *Magazine* giving accounts of his observations during both expeditions. The members of the Society will unite in congratulating him on his new appointment.

At the anniversary meeting of the Royal Geographical Society, Sir George Goldie, the retiring president, in the course of his annual address, drew attention to certain questions connected with the growth, both in quantity and quality, of geographical education in this country. We quote the following from the *Times* report of the address :—Sir George Goldie said that successive councils of the Royal Geographical Society had, especially during the last quarter of a century, made strenuous and unceasing efforts to revolutionise the general position of geography in our national scheme of education. If the Royal Geographical Society had done no other work, it would have amply justified its existence by the success of its labours in this single direction. No one would misunderstand him as endeavouring to conceal or lessen the credit due to our great Universities, to other institutions or associations, or to individual geographers not directly connected with their society, for the important part they had played in the remarkable movement of the last twenty-five years, which had gradually transformed geography from the Cinderella of the sciences into a respected and sought-after branch of human knowledge; but he feared no contradiction when he asserted that the Royal Geographical Society was the initiator, and had been the constant mainspring of that great movement. The efforts they made in order to secure for their subject its proper place in the Civil Service

examinations had been completely successful, thanks to the cordial co-operation of certain of our great Universities, and to the wide views taken in this matter both by Ministers of the Crown and by the Civil Service Commissioners. The effect of this change on the attitude of educational institutions towards their subject was already considerable. It could not fail to be both widespread and deep. The University of Edinburgh had established a lecturership in geography, and the first occupant of that chair would be their distinguished Fellow, Mr. Chisholm; and the University of Sheffield, under the care of its vice-chancellor, Sir Charles Eliot, and with the aid of that liberal citizen, Mr. Allen, had established a lectureship in geography. Lectureships in Glasgow University and other parts of the country were, he believed, likely to be established before long. He referred to an effort now being made by that strenuous and able geographer, Mr. Mackinder, to establish an effective London School of Geography, mainly for teachers, within his highly successful school of economics. This effort had the most cordial moral support of the society, and though the many and varied calls made upon its limited means prevented the society offering to Mr. Mackinder's scheme direct pecuniary support, yet they felt that the relatively small capital sum which was required to equip the proposed geographical department would be obtained without difficulty.

In connection with the progress of geographical education in this country, we note the following proposed changes at Cambridge University:—The General Board of Studies acting on a memorandum received from the Board of Geographical Studies, recommend a reconstruction in the staff engaged in teaching geography in the University. It is proposed that the readership of geography, which becomes vacant in the Michaelmas Term of this year, should be suppressed and three lectureships in geography be established in its place. One of these lectureships will be in historic and economic geography, and will be in connection with the Special Board for History and Archæology. The second will be in regional and physical geography, and it is proposed to connect this with the Special Board for Biology and Geology. The third will be a lectureship of surveying and cartography in connection with the Special Board for Mathematics. The salary of each of the first two mentioned lectureships will be £150 per annum, and that of the last £50 per annum. The last two named will be known as the Royal Geographical Society lectureships in their respective subjects. The council of the Royal Geographical Society have offered to contribute £200 a year for three years to the Geographical Education Fund. This offer the Board recommend should be gratefully accepted. The University will pay a like sum to the same fund.

Mr. R. De C. Ward, of Harvard University, draws attention, in the *Bulletin of the American Geographical Society* for March, to two new "Meteorological Globes" constructed for teaching purposes by Professor Kassner, of the Royal Prussian Meteorological Institute at Berlin. These globes, which are two in number, are nearly 13½ inches in diameter and

show the temperature, pressure, and prevailing winds for January and July respectively, and thus permit lessons to be given on those important points without the use of Mercator's charts, which are generally employed, but are in many respects misleading. The globes are based on all the data available up to the spring of 1907. They show the distribution of pressure by means of isobars in blue, drawn at intervals of 2 mm. The pressures above 760 mm. are shown in solid isobars and those below in broken isobars, so that the great areas of high and low pressure stand out clearly. Temperatures are shown by red isotherms, and all parts of the globe over 0° C. are coloured red, and all those below blue, different shades of the two colours indicating different intensities of heat or cold. The winds are shown by arrows in the conventional manner, and important meteorological stations are shown over the globe. Professor Kassner has also published a pamphlet to accompany the globes. The globes can be obtained from Dietrich Reimer (Ernst Vohsen), Berlin, and are apparently of high educational value.

NEW BOOKS.

EUROPE.

Mittelmeer-Bilder. Von Dr. Theobald Fischer, Professor of Geography in Marburg University. Neue Folge, mit 8 Kärtchen. Leipzig und Berlin: B. Teubner. 1908. *Price* 6 *Marks.*

We reviewed this volume here on its first appearance (cf. vol. xxii. p. 334), and note with pleasure that, like Dr. Philippson's book on the same region (see p. 104), it has passed rapidly into a second edition. Dr. Fischer's book was definitely written with the object of appealing to the general public, and although the scientific aspects of his subject-matter have been further emphasised in this edition, the treatment remains simple and generalised. The point to which we wish to draw attention, however, is that the book makes generally available the results of modern investigation, is sold at a price of *six shillings*, and finds a receptive public. If British publishers could be induced to believe that here also there is a six-shilling-public for books of similar type, we think that much benefit would accrue all round. We find, for example, in Dr. Fischer's book a brief but comprehensive account of the notable peculiarities of the Mediterranean flora, treated from the modern standpoint. It is almost inconceivable that among the thousands of British travellers who visit the region every year there should not be a considerable number who would welcome such an account as a great improvement on Floras of the old type—but where can the traveller of moderate means obtain this in English?

A Trip to Pilawin. By R. Lydekker. London: Rowland Ward, Limited, 1908. *Price* 6*s. net.*

From this daintily got up and beautifully-illustrated book we learn that Count Joseph Potocki, a Russian nobleman, some four years ago enclosed an area of something over ten square miles of forest land in the Schepetowka district of the province of Volhynia, near his ancestral palace of Antoniny, and the enclosure, which is called Pilawin, is now being utilised as a deer-preserve. The forest consists mostly of Scotch fir, oak, birch, and aspen; and within its precincts roam

specimens of European and American bison, elk, Persian and Caucasian red deer, American wapiti, Altai or Sayansk wapiti, wapiti from the Yenisei valley, Pekin or Dybowski's deer, and the Siberian roebuck. These animals roam about, practically wild, and Mr. Lydekker and his daughter were the first English people who had the opportunity of seeing them. Favoured with good weather during the ten days of the visit Mr. Lydekker saw and photographed the animals under specially advantageous conditions, and his descriptions, along with the excellent illustrations, give the reader a very good idea of the progress and results of an exceedingly interesting experiment.

Rock-Climbing in Skye. By Ashley P. Abraham, President of the Fell and Rock-climbing Club, Member of the Climbers' Club. With 30 full-page illustrations in collotype, 9 diagrams of the chief routes, and a Map. London, New York, Bombay, and Calcutta: Longmans, Green and Co., 1908. *Price* 21*s. net.*

It is not universally known that in the Black Coolin of Skye Scotland possesses one of the most attractive climbing fields in the world. Only seventy years ago Principal J. D. Forbes (of glacier fame) may be said to have made the first ascent: thirty years later came the period of Sheriff Nicolson; and during the last quarter of a century the form and character of the rocks and the beauty of their environment have brought to Sligachan crowds of the most expert Alpine men. They have left their mark on the island in many ways: thus, Sgurr Tearlach (Charles) is named after Mr. Charles Pilkington, ex-President of the Alpine Club, Sgurr Thormaid (Norman) is named after Professor Collie, the companion of Mummery in many of his famous climbs. So also, at an earlier date, we have Sgurr Alasdair (Alexander) after Sheriff Nicolson, and Sgurr Mhic Choinnich (Mackenzie) after John Mackenzie, the veteran guide at Sligachan. Due honour has been given to the ladies, too, for a pinnacle on Sgurr Sgumain is known as Stac na Nighinn (the Ladies' Pinnacle), because it was ascended by Mrs. Colin Phillip, wife of the well-known artist, and Miss Prothero. The Black Coolin consists of masses of black basic gabbro which have pierced or upheaved the volcanic basaltic platform which at one time extended over a considerable portion of the north-west coast and islands. It contrasts effectively with the Red Coolin, which consists of pale acid granite belonging approximately to the same period of tertiary activity. But while the granite hills give comparatively smooth surfaces and flowing outlines, the gabbro mountains present a regular sierra formation, a notched and jagged ridge of intensely hard rock, supported by great naked slabs at a steep angle, crossed by many dykes of softer igneous rock, and marked by gullies and stone shoots with little vegetation. There is a controversy as to the meaning of Coolin. It is often translated "holly-trees," which seems scarcely intelligible. Mr. Colin Phillip contends that it means "waste ground," and the Coolin of Rum has certainly the same arid quality. The colour of this gabbro rock has been described by an eminent geologist (Mr. Alfred Harker in his *Tertiary Igneous Rocks of Skye*) as "ranging with varying conditions of light and moisture through every tone of purple, deepening to a velvety black in glimpses caught through a wrack of mist, or brightening to burnished copper under the level rays of a cloudless sunrise." It may be imagined for how much this has counted in the many beautiful pictures that have been painted of the Coolin by Turner, M'Whirter and others, in which depth and strength of colour are as striking as wild irregularity of form. What, however, is of greater importance to the climber is the admirably safe and holding character of the surface of the

rock. What occurs is that the large crystals of augite in the gabbro weather out and leave a kind of nutmeg-grater surface which is specially grateful to the boot of the mountaineer. Apart from geological descriptions, which (until Mr. Harker took the matter in hand) were not remarkable for accuracy, the literature of the Coolin is not very extensive.

Sir Walter Scott's description of Coruisk in the Notes to the *Lord of the Isles* is well known. About 1875 Sheriff Nicolson wrote some charming papers in *Good Words*, and he has left behind him at least two poems which deserve to be classics. In 1889 Mr. Pilkington described the district in the *Alpine Journal*. The *Journal of the Scottish Mountaineering Club* from 1890 onwards contained many interesting accounts of ascents by members of the Club, which has more than once held its meet at Sligachan. In 1907 Mr. William Douglas, the Honorary Editor of that Journal, produced an admirable guide to Skye, supported by a map on which Mr. Harker had indicated several routes through and over the mountains; and now Mr. Abraham, in a book which resembles in design *Rock-Climbing in the English Lake District*, and *Rock-Climbing in North Wales*, has described most of the old climbs and several new climbs. In the *Complete Mountaineer* (1907) a short chapter had already been devoted to Skye. Mr. Abraham's new book is supported not only by an excellent map, but by nine diagrams of routes and thirty photographs of a high order of merit. Several of these were already known, such as the Pinnacle Route, the Third Pinnacle from Knight's Peak, the Gendarme, Sgurr Alasdair from Sgurr Dearg, Loch Scavaig and Sgurr Dubh, and best of all the magnificent view of the Central Ridge called "The Coolin from Bruach na Frithe." But there are several new photographs of great excellence, and the only thing one misses is a view of the beautiful solitude of Coire Ghrundda at the back of Sgumain. It would be an impertinence on the part of the writer to offer any criticism on Mr. Abraham's climbs, for he is a climber *de première force*. On certain days he obviously took considerable risks, mostly caused by the weather, but he was rewarded by unique sensations, such as those he records when standing at midnight on the ridge of Sgurr a Mhadaidh (the Fox's Hill), looking down on Coruisk. It is remarkable how deeply most men are moved by the noble prospects in this "dearest of islands" and how strong the fascination it exercises over them to return. Mr. Abraham is no exception to this rule, for he confesses that the Coolin has displaced even his native Lakeland in his heart. He quotes a fine verse by Godley to express his own sentiments:—

> "We looked from the peak to the limitless distance,
> Saw mountain and sea in the rain and the sun,
> Tasted the ultimate joy of existence—
> Labour accomplished and victory won."

ASIA.

The Uplift of China. By Dr. A. H. Smith. Edinburgh: The Foreign Mission Committee of the Church of Scotland; The Mission Study Council of the United Free Church of Scotland. 1907.

This volume is an adaptation, for the benefit of British readers, of a text-book on Christianity in China compiled by Dr. A. H. Smith of Shanghai. The first half contains brief sketches of the history, religions, and general conditions of the Chinese, and the second is devoted to sketches of the rise and spread of Christianity in China and a statement of the problems and wants at the present time. To each chapter is appended a series of questions, many of which are calculated to puzzle those who attempt to answer them; *e.g.* "Will Chinese ever

be replaced by English or any other language?" "If persecution has been the test of the Church in China, what has been the corresponding test of the Church at home?" The book is illustrated by some fairly good photographs, and the reader is materially assisted by some useful maps and a bibliography, the perusal of which would certainly contribute to a thorough knowledge of the subject in hand.

Travels in Tartary, Thibet and China during the Years 1844-5-6. By M. Huc. Chicago: The Open Court Publishing Society (London Agents: Kegan Paul, Trench, Trübner and Co.), 1900. *Price* 10*s.*

"Much water has run below the bridge" since the time when the simple, kind-hearted, genial Lazarist missionary Evariste Rézis Huc accomplished his famous journey from Pekin to Lhasa and thence back to Macao in spite of difficulties and dangers second to none of those encountered by his many successors in adventurous exploration. The story of the plucky Abbé is now rightly considered ancient history, and it is difficult to realise that its writer died only in 1860. At one time considerable doubts were entertained as to his honesty and veracity, but the observations of later travellers and explorers have amply vindicated the general truthfulness of his narrative, and the *Travels in Tartary, Thibet and China* will on their intrinsic merits remain a classic authority on the peoples and places which they describe,—more especially on the government and conditions of Lhasa, where the mission was permitted to spend a considerable time. The writer is quite unconsciously endowed with a simple, clear, pure, unaffected style, which is indeed he reflection of his own character and mind, and impresses the reader with the conviction that the narrative is thoroughly trustworthy, subject, of course, to the limitations which were the inevitable result of the gentle, kind-hearted missionary's training and vocation. The Abbé is generally harmless as a dove; but, when occasion demanded it, as, for example, in his dealings with the Chinese ambassador at Lhasa, he showed that he possessed the wisdom of the serpent, which he used with the best results for the safety of himself and his colleague. The volume now before us is a second reprint, so we are glad to see that the work has received the welcome, and achieved the popularity, it deserves.

Kelantan, A State of the Malay Peninsula: A Handbook of Information. By W. A. Graham. Glasgow: James Macklehose and Sons, Publishers to the University, 1908. *Price* 5*s. net.*

This "booklet" (as the author calls it) is a compendium of general information after the manner of an encyclopædia article. It is well written and fully illustrated; and as its author holds office as Resident representing the State's overlord, the King of Siam, at the Kelantan Court, the matter it contains may be accepted as accurate and trustworthy.

Kelantan, situated about half-way down the Malay Peninsula on its eastern side, is one of the small states comprised in the northern half of the Peninsula, which are dependent upon Siam. It has an area of about 5,500 square miles and a population, mostly Muslim Malays, of about 300,000. Its physical features are those common to that part of the world's surface—an alluvial plain reaching backwards from the cocoanut-fringed coastline, and fitted for rice and similar tropical cultivation, to the foot of inland hill and mountain ranges covered with forest. Its mineral resources have not yet been fully explored and developed. But they are believed to be extensive, especially as regards tin, if not gold. Exclusive of agriculture, the industries of the state are limited, the chief of them which

supply exports being the drying of fish, cocoanut kernels (kopra) and betel-nuts, the rearing of cattle, and the drying of hides. The population, consisting of the peasants or common people and the nobles or official class, is by nature placid and easy-going, until excited or moved by intrigue; but with the Malay passion for "sport" and gaming in various forms. The present local ruler, succeeding after some generations of intrigue and bloodshed, is styled "Raja" or Chief. He seems to occupy a comparatively secure position, and to conduct public affairs, under superior advice, with prudence and moderation. Much of his territory has been granted, wisely or unwisely, in concessions to speculative syndicates, chiefly for rubber production. But much still remains available for various forms of industrial and commercial enterprise. Any who may interest themselves in these will find this book a useful preliminary source of information.

The Story of the Guides. By Colonel C. J. Younghusband, C.B. London: Macmillan and Co., 1908. *Price 7s. 6d. net.*

It is difficult to speak too highly of Colonel Younghusband's stirring and inspiring book. He had indeed a splendid subject, but it was one after his own heart, and he has loved to do justice to it.

To Sir Henry Lawrence is due the credit of raising the Guides. He saw the advantage which would result from a body of men drawn from the fighting races of the Punjaub; men of undoubted loyalty, invincible courage and endurance, and in addition with trained intelligence and instinct for hill warfare. Their first leader was Sir Harry Lumsden, a soldier who possessed all the best qualities of the British officer, and whose influence on the character of the regiment remains to the present day. Although the history of the Guides only extends over a period of some sixty years, there is crowded into this brief period an almost continuous record of active service. Seldom is it that for any length of time we are without what is termed an "affair" on the Indian frontier, and in these less serious but difficult expeditions as well as in the Mutiny and in the Afghan wars, the Guides have done more than their share of fighting. Two only of their more famous exploits can be mentioned. The first is their historic march during the Mutiny, from Mardan to Delhi, to join the British force at the siege there. The distance is 580 miles, and this they accomplished in twenty-six days, including five days during which they were detained on the route. Within an hour after arrival they went into action. They fought right through the summer of 1857, and took part in the final assault and capture of the capital of the great Mogul. The second was the heroic conduct of a detachment of the Guides, some eighty in number, at the massacre of Sir Louis Cavignari and the other members of the British Embassy at Cabul in 1879. The present generation can recall the thrill of horror with which the news of this tragedy was received, mixed with admiration for the magnificent courage shown by the Guides and their gallant leader, Lieutenant Walter Hamilton. After sustaining the attack of an infuriated soldiery for a whole day, during which all the British had been killed, the remnant of the Guides disdained the offer of their lives from the attackers, and preferred to die fighting in defence of the British flag. In the Report which was afterwards written, it is said, "The annals of no army and no regiment can show a brighter record of devoted bravery than has been achieved by this small band of Guides." The story of the Guides cannot attain too wide a circulation, and no book is better calculated to arouse the patriotic instincts of the youth of the country, or to excite the interest of all who love to read of brave deeds.

From Edinburgh to India and Burma. By W. G. Burn-Murdoch. London: George Routledge and Sons, Ltd. *Price* 10s. 6d. *net.*

This is a very readable book, written in a chatty entertaining style, the reader not being troubled with heavy scientific details. It has been just a little late in making its appearance, as the Prince of Wales's visit to India and Burma is now a matter of ancient history. The author is rather severe on the natives of India, but further acquaintance with them would probably cause him to change his mind on some points. The common people of India, and especially the Tamils and Bengalis, may be of poor physique, and it is a very common mistake for travellers and newcomers to regard them as effete, but the Tamils of Southern India are very different. A coolie will carry a heavy clothes-box on his head for forty miles in a day, and will arrive at his destination in good time. A horse-keeper will follow his master's horse on foot for forty-eight miles in a day, with perhaps only two hours' rest by the way—these are well-known facts.

The writer's descriptions of scenes on the Irawadi are both true and charming, and if only the region were more accessible the descriptions would induce people from this cold, fog-infested country to visit it every winter. It is indeed rapidly becoming known, and in the winter of 1906-7 upwards of a thousand travellers are said to have gone up and down the river. Fogs in the Upper Irawadi are, however, not unknown, and the steamers are often delayed by them as well as by low-water in places. A good honest fog at Bhamo will chill any one not well clothed to the bone.

The ancient city of Pagan with its wonderful pagodas may well be described as "one of the wonders of the world." The Burma flotilla's steamers generally stop at a station called Pagan, but this is too far off to visit the numerous pagodas in the time allowed. There is, however, a rest-house where passengers bringing their own servants and provisions can stay and visit the pagodas at their leisure. The author's statement that the architecture of Burma "probably reached Burma *via* Tibet" is very doubtful, as Burmese Buddhism came from Ceylon, with which island there was great intercourse in the olden times, and it is more than likely that the Burmese form of architecture came also from that island.

The common Burmans of the low country, in spite of their many pleasing qualities, have neither the pluck nor the go of the Tamil or Bengali—Europeans in Burma would be badly off if they had to depend upon them for service of any kind. They are a slow agricultural race and prefer working in the ancestral fields to any other occupation. It is to be hoped that so interesting a people will not be superseded by another race.

AFRICA.

Daybreak in the Dark Continent. By Wilson S. Naylor, Beach Professor of Biblical Literature, Lawrence University, New York. Young People's Missionary Movement: New York, N.D.

This work, which has now reached a second edition, comes to us from America, and is designed to inform its readers as to what has already been done, and what remains still to be done in the way of Christianising the continent of Africa. The writer has stated his case with much enthusiasm, but on the whole very fairly, and in a way likely to awaken great interest in the subject in the minds of his readers. At the end of each chapter there is a series of questions of varying difficulty, which will be found very useful in testing the reader's attention to, and comprehension of,

what he has read. There are some useful maps, a few indifferent photographs by way of illustrations, and an interesting appendix, giving a list of the 97 Protestant societies at work in Africa, with some statistics of their staff and operations, which, however, are very far from being up to date.

AMERICA.

Sport and Life on the Pacific Slope. By Horace Annesley Vachell. London: Eveleigh Nash, 1908. *Price 7s. 6d. net.*

The author of this work on *Sport and Life on the Pacific Slope* is fully qualified for his task by seventeen years' residence and experience; he is also well known as the writer of several other acceptable works. So far as sport is concerned, it occupies but a small part of the volume, and of this much the most interesting chapter is that devoted to sea-fishing, from which we learn that when you hook a tuna "you 'll think you 've snagged a sub-marine island, and then the reel 'll tell you that you 're hitched to a shootin' star." There are also Brobdingnagian black bass, worthy of the attention of the disciples of Izaac Walton. The author caught one weighing 320 lbs. For the majority of readers the descriptions of life on the Pacific Coast will have greater attractions. The author gives us a vivid sketch of what life on the Pacific Slope was some twenty-five years ago, and he portrays with an incisive, and sometimes, we suspect, a regretful pen, the changes which have produced the conditions of society which now obtain. Undoubtedly he has carried out his avowed intention, viz. "to show what life in the West *is*, not what it should be," although the general result is to prove that "the West, intellectually and morally, has proven itself both wild and woolly." This, however, in no way prevents him from anticipating a brilliant future for the West, on the strength of which he hails it as the "Land of To-morrow." The book is full of amusing anecdotes, which successfully illustrate the many topics under discussion, and the author, from time to time, draws conclusions and suggests inferences which have a real value to the merchant, the intending emigrant, and the tourist. The average Englishman, and even the statesman, may find material for serious thought in some of these pages, which warn us plainly that "the vapourings of after-dinner orators upon the unity of the Anglo-Saxon race, upon blood being thicker than water, upon our kin beyond the sea, and so forth, are so much smoke. We are not brothers, nor cousins, nor good friends—and that is the naked truth." The book is well worth reading as the work of a competent and thoughtful observer, who is thoroughly acquainted with the subject with which he deals, and treats it in a friendly and impartial spirit.

America at Home. By A. Maurice Low. London: George Newnes, Ltd., 1908. *Price 5s. net.*

On the subject of America Mr. Maurice Low is certainly one of the most prolific writers on this side of the Atlantic, and long residence in the States renders him well qualified to speak. His style is transatlantic—vivid, shrewd, immensely readable, and not without an occasional shaft aimed at national foibles. Statistics are on the whole conspicuous by their absence, but no clearness of effect is sacrificed by their omission. Various misconceptions about Americans which obtain here are corrected, and various anomalies explained,—why, for instance, there is no such thing as a Labour Party, and why the political woman is unknown. It is shown too how large a part is played in the country by the unwritten law and how enslaved to tradition the American is in many respects. The chapter on Bosses is specially worth reading, but the chief interest in the work lies in the non-political part, and whether the subject be the life of Society at Newport

(where people "pursue expense regardless of pleasure") or a college football match, or servants, or the American Press, it is always interesting and informative. Local vagaries in dressing for the theatre evidently require the careful attention of lady visitors. Each subject is touched with a light and practised hand, and the book deserves a cordial welcome.

GENERAL.

The Statesman's Year Book: Statistical and Historical Annual of the States of the World for the Year 1908. Edited by J. Scott Keltie, with the assistance of J. P. A. Renwick. London: Macmillan and Co., 1908. *Price* 10*s.* 6*d. net.*

This volume has again been enlarged, more space being especially devoted to the British Empire and the United States. The salient geographical events of the year are admirably reflected in the maps of the volume, which show the Anglo-Russian spheres of enterprise in Persia, the new Liberian frontier, the Franco-Siamese boundary, the development of Canada, railway development in China and West Africa, and so forth. The returns of the French Census of 1906 are also given. The volume is as usual invaluable to all geographers.

Lecture des Cartes Anglaises et des États-Unis: Indications linguistiques, géographiques et topographiques. Par Capitaine P. Pollacchi. Paris: R. Chapelot et Cie., 1908.

This glossary has been compiled with a view to assist Frenchmen who have occasion to study maps and charts of the British Empire and the United States and her colonies. It professes to contain translations of all terms employed on such maps, and also indications as to the meaning of abbreviations and conventional signs in use. One column of the dictionary purports to give the language to which each term belongs. The author has here quite evidently confused language with country, but he attributes many words to *Écosse* which are certainly not used out of Wales. Neither is *Sahara* nor *Afrique centrale* a language, nor, to be precise, is *Celtique*. For the purposes of this work the country of usage and not the language of origin is what is required. "Fell," for instance, is attributed to Scotland, while it is far more common in England, and, as a matter of fact, is actually a Scandinavian word. The author is certainly to be congratulated on the inclusion of many little-used words, but we fail to understand his principle of selection when such words are omitted as dell, ness, brae, law, burn, mains, links, (harbour) bar, town (meaning farm-stead), forest (in the term, deer-forest), pack-ice—and we have only cited a few English and Scottish ones that occurred to us at random. There are several inaccurate translations; work-house is not *atelier*, and furze is not *bruyère*, nor is minster equivalent to *monastère*, and it is scarcely correct to translate abroad as *au loin*, or vernal as *printemps*, or the Arabic *chott* as merely *lac*. Captain Pollacchi is wrong in giving *vieille ville* as the translation of altoun. *Alt* has nothing to do with old in this case; it is a Gaelic word meaning a stream, and consequently altoun simply means the farm or settlement on a stream. We notice also that the only rendering given of the word pier is *pile du pont*; surely its more common meaning on maps might have found a place. But more serious errors than these occur, thus, for the expression "Rocks with less than 6 feet at low water," an exactly opposite meaning is given by the author.

Deficiencies such as these mar the reliability of what is undoubtedly a useful volume. Moreover, it is a matter for regret that the pages teem with mis-spelt

English, and are as full of typographical errors as the halfpenny Parisian press. We hope to be able to welcome a second and corrected edition of this work.

NEW MAPS.

EUROPE.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 30th April 1908:—One-inch District Map (with roads printed in colour).—Dundee District, parts of Sheets 48, 49, 56, 57.

Note.—The price of this map is now altered to—flat or folded in Cover, unmounted, 1s. 6d.; mounted, 2s.

Six-inch and Larger Scale Maps.—Six-inch Maps (Revised). Full sheets, engraved, without contours. *Sutherland.*—Sheets 28, 56. Price 2s. 6d. each. Sheet 2. Price 2s. Quarter Sheets, with contours. Price 1s. each. *Edinburghshire.*—13 NW., 15 NW., 21 NW. *Haddingtonshire.*—1 SE., 15 NE., 15 SE., 18 NW.

1 : 2500 Scale Maps (Revised), with Houses stippled, and with Areas. Price 3s. each. *Edinburghshire.*—Sheets I. 13; II. 4, 8, 12, 16; III. 2, 6, 10, 12, 13, 16; IV. (1 and 2), 6, 7, 10, 15. *Peeblesshire.*—Sheets II. 14, 15; (III. 14 and 13); V. 1, 3, 6, 7, 8, 9, 12, 13, 14, 16; VI. 1, 2, 5, 6, 9, 10, 13, 14; VII. 4, 12, 16; VIII. 1, 2, 3, 5, 6, 9, 10, 12, 13, 14, 15, 16; IX. 2, 6, 9, 13, 14; XI. 3, 4, 7, 8, 11, 12, 15, 16; XII. 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15; XV. (1 and 5), 2, 3, 4, 6, 7, 8, 11, 12, 15, 16; XVI. 1, 2, 3, 5, 6, 7, 8, 9, 12, 13, 16; XIX. 3, 4, 16; XX. 1, 5. Sheets V. 4; VII. 8; XI. (10 and 6), 14. Price 1s. 6d. each.

Note.—There is no coloured edition of these Sheets, and the unrevised impressions are withdrawn from sale.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st May 1908:—One-inch Map (third edition), engraved, in outline. Sheet 57A. Price 1s. 6d. Third edition, engraved, with hills in brown or black. Sheets 52, 55, 61, 62, 63, 64, 65, 70. Price 1s. 6d. each.

Six-inch and Larger Scale Maps.—Six-inch Maps (Revised), full sheets, engraved, without contours. *Caithness.*—Sheet 32. Price 2s. 6d. Sheet (31A and 26A). Price 2s. *Sutherland.*—Sheets 4, 14, 15, 20, 22, 24, 25, 29, 34, 39, 41. Price 2s. 6d. each. Sheets 1, 7, (12 and 4A). Price 2s. each. Quarter sheets, with contours. Price 1s. each. *Edinburghshire.*—7 SW., 13 NE., 14 NW., 14 SW., 15 NE., 23 NW. *Haddingtonshire.*—14 NE., 16 NE., 18 NE.

1 : 2500 Scale Maps (Revised) with Houses stippled, and with Areas. Price 3s. each. *Edinburghshire.*—Sheets I. 14 (15 and 11), 16; III. 4, 11, 14, 15; IV. 9, 11, 14. *Peeblesshire.*—Sheets V. 2, 10, 11, 15; X. 13; XII. 2, 16; XVI. 4; XIX. 8, 12. *Wigtownshire.*—Sheets XXIII. 9; XXV. 14; XXXVII. 10.

Note.—There is no coloured edition of these Sheets, and the unrevised impressions are withdrawn from sale.

GEOLOGICAL SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st May 1908:—Six-inch Maps. Quarter Sheets, uncoloured. Price 1s. 6d. each. *Edinburghshire.*—5 SE., 11 NW., 11 SW. *Linlithgowshire.*—(2 NW. and 2 SW.), 2 SE., 3 SW., 6 NW., 6 SW., 6 SE., 10 NW., 10 SW.

EDINBURGH DISTRICT AND PENTLAND HILLS.—Bartholomew's Pocket Map, with Itinerary of Public Paths across Hills. Scale 1¼ inch to the mile. Coloured orographically. New edition, 1908. Price 1s., or on cloth, 2s.

John Bartholomew and Co., Edinburgh.

RIVER THAMES.—Bartholomew's "½-inch to mile" Map of the River Thames from its source to the sea. Coloured orographically, and showing all roads. 1908. Price 1s., or on cloth, 2s. *John Bartholomew and Co., Edinburgh.*

PLAN OF BOURNEMOUTH.—1908. Scale 3½ inches to the mile. Printed in colours. Price 6d., on cloth, 1s.

PLAN OF EASTBOURNE.—1908. Scale 6 inches to the mile. Printed in colours. Price 6d., on cloth, 1s.

PLAN OF HARROGATE.—1908. Scale 8 inches to the mile. Printed in colours. Price 6d., on cloth, 1s.

PLAN OF NEWCASTLE AND GATESHEAD.—1908. Scale 4 inches to the mile. Printed in colours. Price 6d., on cloth, 1s.

John Bartholomew and Co., Edinburgh.

The above are convenient pocket plans specially designed for use of tourists.

ASIA.

INDIA.—North-Western Trans-Frontier. Map of Mohmand Country. Scale 1 : 175,000 or about 2¾ miles to an inch. Reduced from the half-inch Sheets of the Survey of India. April 1908.

Topographical Section, General Staff, London.

AMERICA.

DOMINION OF CANADA.—Railway Map on scale of 1 : 2,217,600 or 35 miles to an inch. James White, F.R.G.S., Geographer, 1907.

Department of the Interior, Ottawa.

A most useful general reference map in eight sheets. The various railway systems are distinguished by colour.

ONTARIO.—Standard Topographical Map. Scale 1 : 250,000 or about 4 miles to an inch. Toronto and Muskoka Sheet. James White, F.R.G.S., Geographer. 1907. *Department of the Interior, Ottawa.*

ONTARIO.—Map of Part of the Districts of Nipissing and Algoma, showing the Townships surveyed near Lake Abitibi. Scale 2 miles to an inch. 1907. (*Presented by Dr. Robert Bell, Ottawa.*) *Department of Lands, Forests, and Mines, Ottawa.*

UNITED STATES SURVEY.—Map of Yosemite Valley, California. Scale 1 : 24,000 or 2⅝ inches to a mile. 1907.

UNITED STATES SURVEY.—Topographic Sheets on scale of 1 : 62,500, or about 1 inch to a mile. 1907. Price 5 cents each sheet. (The figures after the name of each State indicate the number of sheets received.) Alabama, 2; Arizona, 1; California, 1; Colorado, 1; Iowa, 1; Illinois, 2; Maine, 1; Maryland, 1; Michigan, 1; Nebraska, 1; New Hampshire, 1; New York, 5; North Carolina, 2; Ohio, 13; Pennsylvania, 3; South Carolina, 1; South Dakota, 2; Virginia, 2; Washington, 1; West Virginia, 4; Wisconsin, 1.

Topographic Sheets on scale of 1 : 125,000 or about 2 miles to an inch. 1907. Alabama, 1; California, 3; Colorado, 1; Georgia, 1; New Jersey, 1; North Carolina, 1; North Dakota, 1; South Dakota, 1; Virginia, 1; Wisconsin, 1; Wyoming, 1; Yellowstone National Park, 1.

Topographic Sheets—on 1 : 25,000 scale, Utah, 1; on 1 : 48,000 scale, Arizona, 1. *United States Geological Survey, Washington, D.C.*

AFRICA.

GOLD COAST.—Map published by the authority of Sir John P. Roger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1 : 125,000 or about 2 miles to an inch. Sheets 72-J II., Adeambra; 72-K II., Bompata; 72-P II., Asankrangwa; 73-G I., Wupe; 73-G III., Akuse; 73-H III., Denu; 73-M II., and N I., Ada. 1908. Price 2s. each sheet.

W. and A. K. Johnston, Ltd., Edinburgh and London.

SOUTHERN NIGERIA.—Provisional Skeleton Map. Scale 1 : 250,000 or about 4 miles to an inch. Sheets 61-W, 73-C, 73-D, 73-E, 73-I, 73-J, 73-K. 1908. Price 6d. each sheet. *Topographical Section, General Staff, London.*

MOROCCO.– Itinéraires dans le Haut Atlas Marocain, par Louis Gentil. Carte honorée d'une Subvention du Département des Affaires Étrangères, dressée et dessinée avec la collaboration de Marius Chesneau. Echelle de 1 : 250,000. 1908. *Masson et Cie., Paris.*

This map is a valuable contribution to the topography of Morocco. The colouring is geological.

AUSTRALASIA.

AUSTRALASIA.—Stanford's New Orographical Map of Australasia. Compiled under the direction of H. J. Mackinder, M.A. Scale 1 : 5,385,600. In 4 sheets. 1908. Price 16s., or 20s. mounted on rollers varnished.

Edward Stanford, London.

This last addition to this effective series completes the mapping of the continents. The treatment and colouring is uniform with the other maps of the series already described.

NEW ATLASES.

INDIAN OCEAN.—Meteorological Atlas of the Indian Seas and the North Indian Ocean. Prepared chiefly by W. L. Dallas, under the direction of Gilbert T. Walker, M.A., Sc.D., F.R.S., Director-General of Observatories. 1908. Price, half-bound, 17s. 6d. net.

(*Presented by Meteorological Department of the Government of India, Simla.*)
John Bartholomew and Co., The Geographical Institute, Edinburgh.

This atlas is prepared by the Meteorological Department of the Government of India. It consists of thirty-six charts together with descriptive text, and shows the prevailing weather conditions over the Indian Seas. The first twelve charts show for each month of the year the average barometric pressure, normal winds, and sea currents. The following nine charts show storm tracks for each of the stormy months, and the descriptive text gives a short account of them. The last fifteen charts exhibit the special conditions which prevail during the existence of typical storms. In addition to being a most important contribution to marine meteorology, the atlas should prove of great practical value to mariners in these stormy seas. The work has been drawn, engraved, and printed by Messrs. Bartholomew, at the Edinburgh Geographical Institute.

ATLAS OF EUROPEAN HISTORY.—By Earle W. Dow, Junior Professor of History in the University of Michigan. 1907. Price 6s. net.

George Bell and Sons, London.

This is a useful educational atlas consisting of thirty-two plates of coloured maps, eighteen plates of uncoloured maps, and a complete index. It deals with European history in its widest sense and maps its developments all over the world, but, considering that this is an American atlas, one might have expected that British history in North America would have received something more than the very scant treatment devoted to it. The coloured maps are clear and legible although of an elementary character as specimens of cartography.

BOOKS RECEIVED.

We have received the following new books :—

In a Syrian Saddle. By A. Goodrich-Freer. Demy 8vo. Pp. vi+363. London : Methuen and Co., 1908.

Inner Jerusalem. By A. Goodrich-Freer. Demy 8vo. Pp. xvi+388. London : A. Constable and Co., Ltd., 1904.

Outer Isles. By A. Goodrich-Freer. With Illustrations by Allan Baraud. Demy 8vo. Pp. xvi+448. London : A. Constable and Co., Ltd., 1902.

Passion Celtes. Par Charles le Goffic. Crown 8vo. Pp. 180. Paris : Nouvelle Librairie Nationale, 1908.

Le Deuil du Clocher. Par Joseph Ageorges. Cr. 8vo. Pp. 180. Paris : Nouvelle Librairie Nationale, 1908.

Promenades en Savoie. Par Henry Bordeaux. Crown 8vo. Pp. 180. Paris : Nouvelle Librairie Nationale, 1908.

The Geology and Scenery of the Grampians and the Valley of Strathmore. By Peter Macnair, F.R.S.E., F.G.S. Illustrated with numerous Photographs, Diagrams, and Maps. In two volumes. Demy 8vo. Pp., Vol. i., xiv+195 ; Vol. ii., xii+199. *Price* 21*s. net.* Glasgow : James Maclehose and Sons, 1908.

Australasia. Vol. ii. Malaysia and the Pacific Archipelagoes. By F. H. H. Guillemard, M.A., M.D., Cantab. Maps and Illustrations. Second Edition, revised by A. H. Keane, LL.D. Demy 8vo. Pp. xvi+574. *Price* 15*s.* ("Compendium of Geography and Travel.") London : Edward Stanford, 1908.

Picturesque Girvan. Published by the Town Council. Pp. 48. Girvan : Hugh Wallace.

Historical Geography on a Regional Basis. By Ernest W. Dann, B.A. Vol. i., The British Isles. With 6 Maps. Crown 8vo. Pp. x+182. *Price* 2*s.* 6*d.* London : J. M. Dent and Co., 1908.

Pleasure and Problems in South Africa. By Cecil Harmsworth, M.P. With 24 Illustrations. Crown 8vo. Pp. 254. *Price* 5*s. net.* London : John Lane, 1908.

Pentland Walks, with their Literary and Historical Associations. Compiled and edited by Robert Cochrane. With general Map, Illustrations, and Route Maps by George Shaw Aitken. Crown 8vo. Pp. xiv+155. *Price* 1*s.* Andrew Elliot, 1908.

Tramps Round the Mountains of the Moon and through the Back Gate of the Congo State. By T. Broadwood Johnston, M.A., F.R.G.S. With an Introduc-

tion by T. F. Victor Buxton, F.R.G.S. Crown 8vo. Pp. xxiii + 316. *Price* 6*s.* London : T. Fisher Unwin, 1908.

Winter Days in India and Elsewhere. By William George Black. Crown 8vo. Pp. x + 139. Privately printed. Presented by the Author. Glasgow : James Maclehose and Sons, 1908.

New Zealand at Home. By the Hon. R. A. Loughnan, M.L.C. Crown 8vo. Pp. viii + 226. *Price* 5*s. net.* London : George Newnes, Ltd., 1908.

The North-West Passage : Being the Record of a Voyage of Exploration of the Ship "Gjöa," 1903-7 ; with a Supplement by First Lieutenant Hansen, Vice-Commander of the Expedition. With about one hundred and thirty-nine Illustrations and three Maps. Two volumes. Demy 8vo. Pp., Vol. I., xiv + 335 ; Vol. II., x + 397. *Price* 31*s.* 6*d. net.* London : Archibald Constable, 1908.

Through Finland to St. Petersburg. By A. Maccallum Scott. With 24 Illustrations from Photographs. Crown 8vo. Pp. x + 287. *Price* 2*s.* 6*d. net.* London : Grant Richards, 1908.

A Physical, Historical, Political, and Descriptive Geography. By Keith Johnston, F.R.G.S. Maps and Illustrations. Sixth Edition. Revised by A. H. Keane, LL.D., F.R.G.S. Demy 8vo. Pp. xii + 491. *Price* 12*s.* London : Edward Stanford, 1908.

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THE SCOTTISH

GEOGRAPHICAL

MAGAZINE.

THE MURRUMBIDGEE WATER CONSERVATION AND IRRIGATION SCHEMES.[1]

By J. P. Thomson, LL.D., Hon. F.R.S.G.S., etc., Hon. Sec. and Treas., Royal Geographical Society of Australasia, Queensland.

(*With Illustrations.*)

In dealing with the vitally important matter of water conservation and irrigation it is necessary to consider the subject from the geographical as well as from the purely professional standpoint. And it should be fully understood and generally recognised that the one phase of the subject is even of greater importance than the other in its scientific and economic aspects, since the success of any scheme for the control of a large body of water, its distribution and utilisation for industrial purposes, will largely depend on geographical conditions, their comprehension and careful consideration.

The geographical history of the Australian Continent is one of the oldest, one of the most diversified, and one of the most interesting of all the world's histories. It goes far back, embracing immense periods of evolution and change. In the dim and distant past, the eastern and western parts of Australia were represented by some isolated areas surrounded by the waters of a Palæozoic ocean; in the succeeding Mesozoic ages these islands were united from north to south, extending to Asia, but divided in the central region by an enormous gulf reaching northwards to New Guinea and Borneo, and by the next, or Tertiary period, the continent assumed its present form, and the inland waters or Cretaceous sea were limited to a depression near the junction of the Murray and Darling Rivers, and the lake regions in South Australia. Here we have an explanation of the origin of our inland rivers, and the somewhat remarkable saucer-like structure of the continent, whose central depression is a striking feature. And here, too, we have the

[1] See also the *Queensland Geographical Journal*, xxii.

genesis of the great western plains of New South Wales, the Murray river system and the former grand inland streams that once drained the lofty coastal ranges and emptied their waters into the sea at Spencer's Gulf. But these remarkable alterations have not been confined to the topography of the country alone, nor to other associated land forms, for we know that contemporary climatic conditions have undergone corresponding changes, and that our present rainfall falls a long way short of what it was when the luxuriant vegetation of the continent sustained the gigantic faunal types, whose fossil remains have been disinterred from the post-Pliocene drifts of the Darling Downs and Lake Mulligan.

And this at once suggests to the mind the important subject of the evolution of climate, and the effect of this on the present and future conditions of life, with which man is chiefly concerned. There is abundant available evidence to show that remarkable climatic changes have occurred in the geographical history of the continent within comparatively recent geological times, and we are justified in assuming that such evolutionary changes are still going on and will continue to do so all over the world until animal and vegetable life disappears entirely from the face of the earth. The period of extinction is still remote, but none the less inevitable, and will no doubt be preceded by many changes in the faunas and floras of the globe, each succeeding type possessing some distinctive local peculiarity adapted to the natural environment. Even now we are only just recovering from one of those changes in the form of disastrous droughts, which are so inimical to the life of stock. The position is not a happy one to contemplate, for there is no possibility of improvement in the rainfall of the country, as according to the natural and eternal order of things the periods of excessive dryness must become more frequent, more prolonged, and more intensified as time goes on, until the adoption of some palliative means will become an absolute necessity for self-preservation.

There is no use in assuming an air of indifference to existing or impending conditions on the principle that "sufficient unto the day is the evil thereof," when, as a matter of fact, the extinction of our pastoral and agricultural industries is already threatened by recurring droughts. The position demands some definite line of effective action, and the only remedial measures which suggest themselves at present are the conservation of water and the utilisation of impounded rainfall for rural industries. And in this connection it must be borne in mind that in the aggregate our rainfall is ample, and would meet all requirements were it equally and regularly distributed over the country. But we know that it is not so, and that the evil lies in its uncertain and unequal distribution. Our great aim should therefore be to store as much of the rainfall of wet seasons as will help us to tide over periods of drought. And there is no reason why this should not be done wherever facilities exist for the conservation of water.

In many parts of the country we know that the physical structure lends itself in a marked degree to the impounding of large volumes of water, but the natural facilities for a general system of storage can only be ascertained by thorough and efficient geographical examination. And

in the interests of public life and national prosperity it is most desirable that such examination be undertaken and conducted with as little delay as possible. In some of the States, notably Victoria and South Australia, the necessity for water storage and irrigation has already been recognised in a practical manner, and for many years the subject has occupied attention in New South Wales, where the waters of the Murray River and tributary streams have been gauged, the catchment areas examined, and schemes for irrigating the waste bottom lands of the basin formulated. The matter, under the enlightened policy of the present N.S.W. Government, has now reached an advanced stage, as is about to be demonstrated in a practical and impressive way, by the inauguration of the Northern Murrumbidgee Irrigation Scheme, and the construction of an immense dam to conserve the waters of the Barren Jack catchment area, both having recently been sanctioned by Parliament. It is to a consideration of these impending national works, their bearing on the further development of the State, the advantages of irrigation and water conservation generally to Australian settlement and industrial progress, that the present observations are mainly devoted. I have, at the request of the New South Wales Government, recently assisted in the inquiry respecting these works, and geographically examined the country, including an inspection of the reservoir and dam sites.

Unlike the Murray and Darling, the Murrumbidgee River lies wholly within the territory of New South Wales. Emanating from a source in the elevated tableland at the base of Peppercorn Hill, some five thousand feet above sea-level, and distant a few miles NW. from the town of Kiandra, it flows south-easterly to the left of the dividing Range, which separates it from the head-waters of the Snowy River, to a point about five or eight miles in a north-westerly direction from the town of Cooma. In consequence of the somewhat remarkable *cul-de-sac* configuration of the Main Coast Range and great Alpine chain of the Victorian Cordillera, the river is here deflected for probably one hundred and twenty degrees, and, taking at first a northerly course, runs for some considerable distance parallel with the Goulburn-Cooma Railroad, from which it trends north-westerly to its junction with the Yass River. Down to this point the Murrumbidgee receives the Umaralla, Bredbo, the Molonglo and other important tributary streams, and traverses a tract of country possessing some remarkable features of great natural beauty, especially at the head-waters, where the mountain spurs are steep and rugged, and the lateral valleys deep and precipitous. The catchment area of this region, in the Counties of Beresford, Cowley, Murray, and Buccleugh, and comprising the famous tableland of the northern Monaro district, and the basin of Goodradigbee Creek, is about five thousand square miles. This is mentioned now, as the matter will enter somewhat largely into the discussion of the subject later on. From the Yass River junction the Murrumbidgee strikes westerly, and flowing through the famous Riverina district is joined by the Lachlan River below Hay, and farther down is united to the Murray River at Balranald; the total length of the stream to this point of union being 1350 miles. From its source to the Cooma bend, 170 miles, the average fall of the Murrumbidgee River is about

11 feet per mile, then down to the Yass junction the gradient is lowered to 4 feet per mile, and on to Narrandera to 2 feet per mile.

The lower section, of some 470 miles, between this last place and the Murray junction, has but a slight fall of barely 9 inches per mile, which circumstance favours the inundation of extensive areas of the bottom lands of the basin, when the river is in high flood. The official estimate of the yearly flow of the river at Narrandera is as follows:—

4,000,000	acre feet	in a	flood year.
2,000,000	„	„	fair year.
1,000,000	„	„	dry year.
600,000	„	„	year such as 1902.

These results are, however, inconclusive, obtained as they have been from rather insufficient observations, covering but a comparatively short period of six years, during which time the river was systematically gauged.

Geographically considered, these physical conditions correspond to three distinct hydrographical divisions of the river basin, in which corresponding changes in the geological structure of the region occur. The first of these divisions includes the head-waters, covering an area of some five thousand square miles, and comprising the catchments of the river and tributary streams, down to the junction of the Goodradigbee Creek, as previously mentioned. For descriptive purposes this may be referred to as the Upper Region or Barren Jack catchment. Here the hydraulic gradients are steep, the declivity of the water channels being sharp, and the numerous tributary streams are consequently rapid and torrential in character when flooded, cutting deep into the rocks and soils, whilst their lateral erosive action augments the sedimentation of the waters, and contributes to the fertilisation of the lands lower down.

The orographical features of this Upper Region are chiefly represented by a circumscribing mass of mountains, the eastern side being flanked by the great coastal range, here from 2000 to 3000 feet high, that stretches away northwards along the whole seaboard of the continent to Cape York, separating the waters that flow easterly to the Pacific Ocean, from the inland waters. On the south and south-west this range is united with the lofty Alpine chain of from 5000 to 7000 feet in altitude, whose culminating peak is Mount Kosciusko, at the head-waters of the Murray and Snowy Rivers. Apart from the magnificent scenery, the panoramic views and the sublime natural beauty of vegetation, hill and dale, which here present themselves, the country is especially interesting to the student of Geographical Science, as being the birthplace of the Australian Continent. Here in the early morn of the Palæozoic period appeared an isolated mass of land, to which in the succeeding age were united other masses along the extensive eastern coastline already referred to. At the beginning of Mesozoic times the lofty summits of the mountains that were crowded together in this neighbourhood must surely have formed a magnificent picture in striking contrast to the present landscape. The range was then over 10,000 feet high, and the stupendous culminating peaks of the Cordillera would probably act as accumulators for the densely

packed vapour clouds, which, no doubt, enveloped the region, precipitating their copious waters on the luxuriant vegetation of the period. The associated torrential rainfalls would sweep down and along the steep and rugged slopes of the mountains, carrying with them enormous deposits of fertile soils to the great river valleys, low-lying plains and marshes below. In this manner the vast central depressions of the continent were filled up and the western plains of the interior formed by the basaltic detritus subsequently washed down in later times from the adjacent ranges. The great inland rivers which then drained the slopes of the rugged coastal ranges and emptied themselves into Spencer's Gulf were amongst the most striking topographical features of the country. As further characteristics of the Upper Region of the Murrumbidgee, it may be remarked in continuation that the physical features of the circumscribed inner area consist chiefly of tableland country and high plains, rising by steeply timbered ridges to the Snowy Mountain Range, where there occurs an extensive tract of treeless downs, of from 5000 to 7000 feet above the sea-level. Here, the snow mantles the surface of the ground for half the year. The northern Monaro Plains are extensive, stretching as they do from Michelago to the range dividing the waters of the Murrumbidgee and Snowy Rivers. With the exception of small isolated patches of stunted trees, the elevated area is denuded of timber and scrub, a condition no doubt responsible for the somewhat inappropriate geographical terminology, "Plains," suggesting flat or level country, while an undulating surface actually occurs, with moderately high peaks in places. Geologically these high lands are of trap formation, basaltic lavas and igneous rocks being abundantly represented over the whole region, with surface stones scattered about in all directions. There is, however, a thick crop of short, sweet grass all over the plains, and this has rendered the district famous for sheep-farming since the earliest days of settlement and colonisation, some of the fine Merino wool, for which the State has so long been noted, being largely produced there.

As to geological structure, the watershed ranges consist chiefly of ancient Silurian deposits of two periods, the lower deposit probably corresponding to the European and North American Cambrian or Laurentian formations. Granites, syenites, porphyrys, and other plutonic rocks are also largely developed on most of the summit ridges of the Alpine chain, and these sometimes occur in the form of intrusive igneous rocks of a later period. But the Palæozoic formations have a wide range, being distributed over extensive areas of the continent, and constituting the principal mountain masses, and the great dividing ranges. They occur in the Blue Mountains, the Pyrenees, the Grampians, and are largely developed in Western Australia, South Australia, and Queensland. To them belong the rich auriferous rocks, the metalliferous strata and the carboniferous beds which have rendered the country famous since gold was first discovered in the early days of settlement. And these ancient deposits are rich in fossiliferous remains, a determination of whose species has thrown a flood of light on the fauna and flora of the continent during the early life of the

world and enabled us to read with tolerable accuracy the history of past ages, of whose physical and climatic conditions nothing could otherwise have been known.

The vegetation of these watershed ranges of the Upper Region, including also the sources of the Murray and Snowy Rivers, partakes more of an Alpine character than the plants found elsewhere in the basin of the Murrumbidgee. The ridges are mostly timbered with belts of mountain ash and other local varieties; but there are elevated plateau lands, locally known as the Snow Country, where tracts of treeless downs are met with, and these latter, being carpeted with rich nutritious green grasses during the summer months, are valuable pasture lands, more especially in times of drought, when stock suffers so greatly on the plains below. Botanically considered this Alpine region, reaching an elevation of 5000 feet above sea-level, and its extension into Victorian territory, possesses some specially interesting features in regard to the wide distribution of plant life and the intermingling of species common to both hemispheres of the globe. While some of the forms are distinctly local in character and peculiarly Australian in type, there are many others corresponding to and not a few actually identical with those of the highland zones of Europe. And this remarkable commingling of terrestrial vegetation is not merely restricted to a few particular genera, but we have it on the authority of Sir Joseph Hooker that it includes many species as well, which circumstances doubtless contribute much to the singular beauty of the flora peculiar to the colder parts of this quarter of Australia, and perhaps in a lesser degree to New Zealand.

The next section of the Murrumbidgee basin will be herein known as the "Middle Region," and extends down to Narrandera. It embraces some hilly and undulating country, and below the Tumut River junction extensive plains are met with, but considered in the light of a geographical unit no striking topographical or even physiographical features present themselves for special treatment.

For pastoral purposes the area under consideration is eminently adapted, but although some patches of alluvial deposits occur at the junctions of most of the tributary streams, such lands are usually too limited for extensive agricultural operations, without the aid of some fertilising agent.

The prevailing geological conditions are here represented by a wide distribution of Lower Palæozoic strata and the occurrence of plutonic rocks, the granites being developed over fairly large but not continuous areas, more especially where hills form the dominant surface features of the country. But these representative formations are comparatively simple in their structure and present no complicated phases requiring further elucidation. The vegetation, too, is likewise typical of the western country, comprising the immense tributary drainage areas of the Murray River system, and is chiefly represented by the ordinary forest timber trees so familiar to the settlers since the early days of colonisation. The various gums, the blood-woods, the stringy-barks, the iron barks and the boxes are readily recognisable amongst the forms met with, and some of these attain striking proportions on the rich

alluvial frontage of the river and tributaries. But the same may be said of many other parts of the continent, for there is a strange similarity about the timbered areas of South-eastern Australia, whose "bush" vegetation is characterised by the sombre and uniform colour of the foliage peculiar to the eucalyptus and the remarkable "scrubs."

The third division of the basin will be designated the "Lower" Region, and extends downwards to Balranald, where the waters of the Murrumbidgee unite with those of the Murray. The whole area is almost devoid of orographical features and consists of extensive plains, some being over fifty miles across, which are frequently treeless. This is especially so in the case of the "Old Man Plain," adjoining Hay on the south, and the "One Man Plain," between Hay and Booligal, both of which sustain patches of saltbush, scattered clumps of stunted trees and nutritious herbage, on which the numerous flocks of the district flourish, the locally grown wool having acquired a favourable reputation for both quantity and quality.

The geological character of the country differs greatly from that of the two preceding regions and is remarkable for a wide distribution and development of Tertiary rocks, distinguishable into Pliocene, Miocene, and Oligocene. This Tertiary group is widely distributed over the whole lower basin of the Murray River system, extending into the south-western parts of Victoria, and terminating at the Ninety-Mile Beach, along the shores of Encounter Bay on the west, and the mouth of the Glenelg River on the east. But there is an interruption to its continuity along the Victorian seaboard, by the occurrence of Primary and Plutonic rocks, notably the granites, which are, however, not developed as a continuous formation along the coastline, but rather in detached masses.

In considering the geographical conditions of this region as a whole, we are led to the conclusion that the Tertiary formation owes its origin to the river drifts of the Murray system that have accumulated for ages on the floor of the basin, gradually filling it up, from remote times, to the present level. And this also furnishes an example of the formation of river valleys, deltaic areas, and alluvial plains, showing a result of the intense erosive action of water on the solid crust of the earth, and standing as an object lesson in the process of reclaiming the great, central depression of the Continent, since the disappearance of the Cretaceous sea.

We are now brought to a brief consideration of the climate and rainfall of these Murrumbidgee areas, their influence on settlement, vegetation, and animal life generally. From the preceding remarks on the orographical features of the basin it will be readily concluded that the upper and lower regions differ very markedly as regards climatic conditions. On the mountain ranges and high tablelands of the former there is a low temperature almost all the year round, the winter cold being severe. In places the snow is heavy, but not perpetual, and does not remain so long unthawed as at the head of the Murray, where, in the higher parts, the shaded slopes may not be altogether uncovered for more than once in every ten years. On the northern Monaro plains and

neighbourhood there are long and cold winters, and even in summer the temperature occasionally falls to freezing-point, when crops susceptible to the influence of frosts may suffer. But, on the whole, the climate is delightfully healthy during the summer and autumn, when out-door life is most enjoyable, the local conditions of climate being certainly superior to those of the Dalgety area, to the south-west, which is lacking in some of the more essential elements to recommend it as a first-rate site for the Federal capital, as suggested by the Commonwealth Parliament. At Cooma, on the elevated plains, 2636 feet above sea-level, the mean temperature is fifty-four degrees and the range falls from a maximum of 107 degrees to a minimum of twelve degrees, but over the whole of this tableland country the mean thermometer reading may be taken at about fifty degrees Fahr. throughout the year, and the rainfall at twenty inches. At the sources of the Murrumbidgee and Tumut waters the isohyetose lines of 50 and 60 inches denote the greatest precipitation that occurs in the district, while the rainfall of the remaining portion of the Barren Jack catchment, or Upper Region, may be put down as varying from 20 to 30 inches. Passing on from here the temperature increases and the rainfall diminishes with the descent of the river, until the lower section is reached, where we find from 12 to 18 inches of precipitation; and in the Middle Region, from 18 to 20 inches, with moderately high summer temperature and cold winters. But in the Lower Region the extremely dry heat of the summer is intense, the mercury sometimes rising to 110 degrees or 120 degrees in the shade, and the range is correspondingly great, for in winter it falls to freezing-point. But, on the whole, it may be noted that, for some eight or nine months of the year, the climatic conditions are agreeable, the winter season being delightfully bracing and eminently favourable for consumptives, or those who suffer from respiratory troubles. Settlers are, however, chiefly concerned about the rainfall, which for most economic purposes is uncertain and deficient, especially so during the occurrence of droughts, whose disastrous effects are not wholly unknown in many other parts of the continent, the only possible remedy being the systematic conservation of water.

This now suggests a reflection on the important subject of evaporation and its influence on large storage supplies of water. It is a matter to which I may fairly claim to have given much attention. My own views thereon have been very fully expressed elsewhere and are set forth in detail in the literary transactions of the Royal Geographical Society of Australasia, Queensland. They embody the results of careful and extensive investigations, covering many years of actual research, and, stated briefly, are to the effect that in every instance examined the loss by evaporation has been greatly underestimated. This is especially so in the case of artesian supplies, whilst the Evaporation observations on the waters of the Murray River system are inconclusive, as they have been made under circumstances in nowise conforming to the natural conditions obtaining. Experiments made on purely artificial data or on the surface of a lake, whose entire sources of supply or means of loss are unknown, or at best merely conjectural, must, in the nature of things,

have little scientific value, and may, as likely as not, be actually misleading. In any case a closer approximation to the truth is more likely to be obtained by assuming that the amount of water lost by evaporation under existing conditions is probably fifty per cent. greater than generally estimated, and on the western plains it is certainly more. At Walgett the yearly evaporation is said to be 65·494 inches; at Wilcannia, 68·976 inches; and at Dubbo, 71·504 inches; these results having been obtained from observations extending over a period of ten years, from 1st January 1893 to 31st December 1902. It would therefore be wise to keep these in view when formulating any scheme for the conservation of water and its application to economic purposes, whether for raising power, irrigating land, or merely watering stock. Especially should these results be borne in mind in utilising the waters of the Murrumbidgee River for fertilising the lands of the Lower Region, where local conditions favouring rapid and excessive evaporation exist in the highest degree, and are probably little inferior to those obtaining in the arid plains of Central Australia, on which the finger-nails break off in brittle pieces under the influence of excessively dry air. As illustrating the widely different views on this subject, it is only necessary to refer to the evidence adduced at the sittings of the Royal Commission on the conservation of water in 1884, in which certain values are assigned to the results of experiments conducted by qualified observers in New South Wales and elsewhere, under varied conditions and circumstances. And, again, we may refer to the masterly summary of such evidence, in which the Commissioners are careful to emphasise the fact that "in the present state of our knowledge upon the subject, opinions vary considerably." They might have gone further and added with equal clearness and cogency that existing experimental methods and appliances are inadequate, and calculated to give erroneous results, the tank system being to my mind one of the most unsatisfactory methods adopted, and one whose obvious defects are the dissimilarity to the natural conditions of a moving liquid mass or even a liquid body at rest. In a comparatively young country like Australia this matter has as yet received but little consideration from those chiefly interested, and yet it is of paramount importance in all enterprises where the economic utilisation of water is concerned. For in possessing a knowledge of the quantity of water evaporated from a given area, we are not only furnished with information concerning local winds, temperature, and surface conditions, but we are armed with material of great value in the construction of storage reservoirs and irrigation canals, so as to limit the exposed surface areas as much as possible, thereby affording the greatest protection against loss, which in hot and dry localities must obviously be considerable, even after making all due allowance for exaggerated reports and faulty observations.

The economic or industrial phase of the subject of this paper having now been reached, it becomes possible, in the light of the knowledge acquired by our geographical exploration of the area under consideration, to make an intelligent examination of the facilities afforded for the systematic utilisation of the Murrumbidgee waters. In doing so we

must first of all remark upon the evidence of the impermeability of the strata of the Upper Region as revealed by a study of the physical structure of the locality, and the favourable conditions which exist for the storage of large supplies of water. We have furthermore shown that the climate is excellent and the rainfall abundant, while in other respects the area forms one of the best catchments to be found in the whole of the State. It is drained by several important streams of steep declivity

FIG. 1.—Site of proposed Barren Jack Dam.

by which the waters from the melting snow on the lofty ranges and the annual rains are rapidly carried to the lower regions of the basin before suffering any serious loss from local causes. The sources of supply are singularly free from the contaminating influences of physical conditions, and there is no probability of immediate failure through deficient precipitation during normal seasons, augmented as the supply naturally is by periodic snowfalls on the higher levels. With the exception of the Tumut River drainage and some minor streams, this Barren Jack catch-

ment includes the whole of the contributing area of the Murrumbidgee basin, and owing to the natural configuration of the country the gathering ground is singularly circumscribed by an annulating rim of impermeable rocks, which greatly contributes to the successful storage of immense supplies of water, and renders the construction of retaining dams possible. In no other basins of the continent do we find greater natural facilities for impounding a large percentage of the rainfall, and nowhere else are the associated geographical conditions more ideal in their character, more diversified in their scenery, or more typically Australian in their vegetation.

In determining the feasibility or otherwise of conserving the waters of this catchment the question of suitable dam sites requires careful consideration. As a result of detailed examination by officers of the Public Works Department, some three localities have been suggested as affording natural facilities for the construction of dams, that known as Barren Jack having been finally selected. This is situated about three miles below the junction of the Murrumbidgee and Goodradigbee rivers, and distant some twenty-one miles SW. from Bowning, on the Great Southern Railroad, where the river has cut a deep gorge through the ridge of granite rocks that lies across its course, affording natural facilities for impounding immense quantities of water. Here we have an example of the erosive and disturbing action of great volumes of water when confined to the narrow channel of a stream of steep declivity, illustrating in a marked degree the life history of a tributary river flowing through mountainous country. Like many of our Australian watercourses, the Murrumbidgee is but a miniature stream, so to speak, compared with its former majestic proportions, when it was two or three hundred feet above its present level, and spread out over a channel of probably not less than a mile across from bank to bank. In the comparatively narrow gorge between Barren Jack Mountain and Black Andrew the torrential waters and floating ice masses of past ages have left their indelible imprint on the broken and distorted granite masses that are scattered about in all directions, or piled together in disordered and confused heaps elsewhere.

Geographically the locality is bold and rugged in its topography, and the true character of the rock structure is obscured by the chaotic condition of the river channel through the granite formation. Exposed for ages to the influence of the elements, the sides of the gorge have thrown off great masses of granite blocks that are fractured and broken up into all shapes and sizes as they rest on the precipitous slopes or in the bed of the river, concealing the true structural character of the underlying strata. Lithologically considered, the exposed boulder granite rocks are not of an especially good texture, the grain, though fairly fine, not being exceptionally compact and dense. They belong to the Palæozoic series of plutonic rocks so largely developed on the watershed ranges in which the river has its rise, and are not merely of purely local occurrence, but form a continuation of the great system of Silurian strata to which allusion has been made above. Associated with this granite formation in the circumscribing ranges of the watershed are other porphyritic

igneous rocks of Palæozoic age, whose impermeable nature would form an effectual barrier against the loss of impounded waters, rendering the locality an ideal site for a storage reservoir.

Three possibilities were at first suggested for the construction of a dam at Barren Jack, the intention being to raise the barrage in stages to 120 feet, 170 feet, and ultimately to the full height of 200 feet, which would have spread out the time of construction over a period of seven years from the 120 feet stage. But I was not in favour of this proposal, strongly recommending on scientific and professional grounds that the work should be carried on from start to finish without any stoppage. It was finally decided that the dam should "be constructed to its full height, 200 feet, the work of construction to proceed continuously to completion," the estimated cost, including land resumption and protective works, being put down at £810,000. With a dam of this description the reservoir capacity will be 33,380,864,000 cubic feet, and the water area no less than 20 square miles, the Murrumbidgee River being held back for a distance of 40 miles, the Goodradigbee River 15 miles, and the Yass River 24 miles from the dam site.

It will generally be considered that the proposal to carry the dam to a height of 200 feet is extremely bold as an engineering enterprise in a country where experience is not ripe, and all undertakings of the kind must for a long time to come be purely experimental in their more essential characteristics. In a country like America the idea would present no novel features of importance, but to the British mind the case is somewhat different, and in reporting on the scheme I felt obliged to plead for the lower grade of 150 feet, which in my opinion the height of the dam should not exceed. It was pointed out that the impounded water area of the Barren Jack Reservoir will be more than one and a half times that of Sydney Harbour, the storage capacity being little inferior to the great Assuan Barrage of the Nile, while the hydrostatic pressure at the base of the dam will be dangerously high and destructive to the works should any flaw be discovered. The fall of the river and height of dam are greatly in excess of those at the Nile Barrage, where the slope of the ordinary channel for some seven hundred and seventy miles upstream is only about 5 inches (1/12,000) per mile, against as many feet in the Barren Jack Area. The exposed liquid surface of the reservoir will be highly favourable to maximum loss by evaporation in a locality such as the Middle Murrumbidgee, where the summer temperature is fairly high and the percentage of humidity low. And it will also be readily understood from the comparatively steep declivity of the river, and from associated local conditions, that the velocity of the water through the dam sluices will be very great when the reservoir is full, rendering extreme caution necessary in such a gigantic enterprise, bearing in mind the lesson afforded by the construction of similar works on the Nile, to which incidental allusion has been made.

From a detailed exploration of the Murrumbidgee River it was found that besides the Barren Jack site there were two other places higher up the stream where the natural facilities were favourable to the storage of water. The remotest of these is located at a place where there is a

deeply eroded channel through the rocks forming the bed of the river, about ten miles NE. of Kiandra. Here the construction of a dam 125 feet in height would impound a considerable body of water of an estimated volume of about 216,200 acre feet, representing the drainage from a catchment area of 128 square miles of high mountainous country, noted for heavy snowfalls and copious precipitations. The other site is below the junction of the Murrumbidgee and Umaralla Rivers, some twenty miles north of Cooma, where the occurrence of a rocky gorge would facilitate water storage. But here under existing conditions of railway improvements and bridge works the height of a dam would be limited to 60 feet. This however would not hold back sufficient water for the purpose of flooding the available lands in the Lower Region, where irrigation works are to be inaugurated as part of the State Scheme under review, and to which some attention must now be given.

From our knowledge of the geographical conditions of this region we are enabled to delineate the characteristic features of the country and to make clear the aridity of most of the area. From the low rainfall of less than 20 inches it must be evident to any intelligent person that, in their present natural state, the lands for all practical purposes are arid and of no commercial value. But the soils would readily respond to the fertilising influence of artificial watering from storage dams higher up the stream, and the Departmental Scheme under consideration is calculated to bring about an entire and greatly needed change in the economic utilisation of this area. The summer thermometer readings are usually high, although on the whole the climate is delightfully genial, but the district thirsts greatly for an adequate water-supply for the development of its agricultural industry, and until this natural craving is satisfied the rural settlement of the locality must necessarily be much restricted. Between Narrandera and Hay there lie on both sides of the river two fairly large irrigable areas, comprising on the north side some 750,000 acres and on the south side 912,000 acres. But for present purposes the former of these has been selected, and in this section the Government proposals are based upon an area of 196,000 acres of first-class lands and 162,000 acres second-class land, or in all 358,000 acres for operative purposes in connection with the storage waters of the Barren Jack Reservoir. For diverting these waters from the main channel of the Murrumbidgee to the service canals a weir and regulator will be constructed at a granite bar near the Bundigerry Creek junction, about nineteen miles above Narrandera, and from this place downwards to the terminal point the supply will flow through a course of 132 miles from the offtake. Including weir and regulators the final estimate for artificial channels or service canals is £764,000, which being added to the former amount put down for the Barren Jack dam and protective works, will bring up the total cost of the scheme to £1,574,000. The diversion site above Narrandera has been selected in preference to any other suitable locality lower down the river, as commanding the largest possible area of irrigable country, as affording the opportunity of utilising the storage waters to the best advantage, to increase the reticulation gradient by diverting the waters from a higher level, and, as Mr. Lee, the Minister

for Works, so ably and tersely puts it, "to get the greatest result possible from the proposed expenditure." With this view I entirely agree. But at the same time the fact must not be overlooked that the length of service canalage will be in proportion to the distance of the offtake from the storage site, and that the loss of water by evaporation, soakage and other contingent causes will be increased in proportion to the extent of country traversed and the distance from the diversion weirs to the fields.

In the scheme under consideration this will likely be considerable not only in the earlier operative stages, but even when fully matured, unless the canals are lined or the water is transmitted through wooden

Fig. 2.—Portion of the Reservoir Area.

or mental troughing. In any case it will be a difficult matter to minimise the loss caused by evaporation in a climate like that of the Riverina district, where the temperature is high and the air exceedingly dry.

I should now like to offer some remarks on irrigation generally, as understood and carried out in other parts of the globe, my own personal observations during a recent tour of the world enabling me to do so with greater facility than would otherwise be the case. Irrigation, it may be remarked, is the fertilisation of land by the artificial distribution of water over its surface. It is necessary for agricultural purposes where there is irregular or deficient rainfall, or in places where the rains do not fall when most wanted. This occurs in many parts of the world, and even in tropical countries the cultivated soils sometimes require to

be vitalised by the application of water from perennial sources, otherwise the crops would fail. The idea of artificially flooding the land for the purpose of crop-raising goes far back into antiquity. In Asia and in some parts of Europe it found practical expression centuries ago, and even among the primitive races the art of utilising the waters of local streams for enriching garden and plantation soils has been long known, and is practised to this day in many places of the world. This is notably the case in the islands of Polynesia, Melanesia and Micronesia, where irrigation in its simplest and most primitive form enters into the economic conditions of life to an extent not usually understood in many countries where it is far more needed, and where, moreover, the greater advantages of enlightened civilisation lend themselves to wider developments and more profitable enterprises in agricultural industries and to a higher appreciation of the value of an adequate water-supply. One of the earliest forms of irrigation consisted in raising river, lake or well water by hand and pouring it on the land. In Egypt this was done centuries ago, when the water was raised by a bucket suspended to the short end of a long pole fixed to a movable axis and balanced at the opposite end by a heavy weight. By these means the water was raised some fifteen or sixteen feet to the land, and even now the numerous small fields that are scattered along the banks of the Nile are watered in the same way. And in northern India the primitive shallow bucket suspended between two strings is used to raise water on to the cultivated fields, where remarkably good crops reward the industrious cultivators, who in the absence of this method of fertilisation would be forced to abandon the land and seek some other means of living. But the broad alluvial plains of fluviatile valleys afford greater scope for the development of irrigation works on more modern lines as well as for the accomplishment of large undertakings, according to approved methods, and the inauguration of vast industrial enterprises, for the economic utilisation of river waters. In Italy, for instance, the plains of Lombardy and Piedmont afford a striking example of the results of high-class irrigation and furnish an object-lesson in which every variety of conditions is fully illustrated. Unlike the primitive Polynesians, who divert their river waters at suitable places and carry them on to their plantations by the remarkably effective means of bamboo piping and open ditches, or the Nile peasant, who raises by his counterpoised Shadoof enough water for the fertilisation of his four-acre holding, or the coolie, with his comparatively modern water-wheel, the Lombardy farmers have profited by long experience, and aided by the best class of engineering works, are enabled to utilise the abundant supplies derived from the River Po, lakes Maggiore and Como, and other great sources, to the best advantage. But this is the result of generations of experiments and extended enterprises in a country where the melting Alpine glaciers and snowfields augment the great torrents of the Dora Baltea and Sesia, and render the water-supply inexhaustible and regular. Then again, we have another interesting example of vast supplies as furnished by the Ganges, the Jumna, and the great Punjaub streams, used for watering the extensive plains of northern India, where irrigation is met with on a gigantic scale. And

in Southern India too, there are, besides the three great streams draining the Ghats, a series of large reservoirs and tanks whose waters are carried on to the land by a system of canals quite adequate for all local requirements. There is no other country where irrigation is carried on so extensively as in India, and in no other part of the world are the facilities for successful works of the kind so great. In many of the native States tanks and dams are scattered about in all the valleys, and in the territory of Mysore alone there are no fewer than 40,000 reservoirs, the physical conditions of the country being highly favourable to the construction of these. But for gigantic undertakings having for their purpose the conservation of water on a scale unsurpassed in any other part of the world, we must go to Egypt and study the Nile Barrage as well as the great Assuan Dam and Reservoir, which were recently opened with imposing ceremonial, and whose completion within the incredibly short time of four years has astonished the world, and marked another triumph of British engineering, enterprise, and genius. The stupendous nature of this great impoundage scheme, whose chief object is the perennial irrigation of the lands of Upper Egypt, thereby enabling the agriculturist to grow two crops a year instead of one, as formerly, can hardly be realised by the presentation of a series of figures representing the dimensions of the undertaking. But it is interesting to note that the massive granite structure forming the dam across the valley is 6400 feet long, 82 feet thick at the base, and 23 feet at the crest, the whole solid wall rising 130 feet above the bed-rock of the river. The capacity of the reservoir, which is 66 feet deep, and extends for more than 100 miles up the Nile Valley, is 38,000 million cubic feet of water, and the Nile flood is passed through 180 sluice-gates in the dam, capable of discharging 360,000 cubic feet per second. The entire works will command 450,000 acres of irrigable basin lands, and when completed the whole scheme, including the minor dam at Assiut and distribution canals in Upper Egypt, is estimated to cost six and a half million pounds sterling.

And we have it on the authority of Sir C. Scott Moncrieff, to whose most recent writings I am indebted for these statistics, that this will have the effect of increasing land rental by about £2,637,000, and the market value of the land by £26,570,000. But this is not all, and we must take into account the far-reaching influence of such remarkable developments on the general prosperity and industrial life of the territory as a whole. And it must be borne in mind that this influence is not wholly represented by the increased local values to which we have alluded, but there are other sympathising and susceptible elements that have to be noted when considering the scheme in the light of its effects on the country at large.

Although of comparatively recent date, irrigation in the new world has already assumed colossal proportions, and in the Western States of America vast areas of waste lands have been reclaimed, and are now occupied by enterprising and industrious cultivators. At the present time the area controlled by elaborate systems of irrigation there is probably not less than 10,000,000 acres, and these lands, which formerly

were not worth more than from 10s. to 20s. per acre, have now risen to £8, 10s. per acre.

Although timber enters somewhat largely into the calculation of the American engineer there are many of the water works conceived and carried out in the United States on bold and liberal scales, which far surpass any undertakings of the kind in the Old World. But America is a progressive country, where vast tracts of arid lands afford wide scope for the development of great enterprises, and the people there are not slow to recognise the immense advantages of an adequate supply of good water for the fertilisation of the soils. With them the average cost of bringing the water on to the land is about 32s. per acre, and the farmer is charged a water rate of from £2, 8s. to £4 per acre, with an additional payment of from 2s. to 10s. per acre yearly, to cover the expense of maintenance. The cost of service canals vary from £100 to £150 per mile, the former being for a channel 5 feet wide and the latter amount for one 10 feet wide. Having briefly alluded to the progress of irrigation in countries where the economic utilisation of storage water is necessary to the industrial prosperity of the people, I will consider for a moment the comparative conditions under which such works have been established, and the possibility of similar enterprises being carried on profitably in Australia.

In Egypt the rich deposit-laden waters of the Nile, which rise and fall with never-failing regularity, and are unapproachable in their fertilising elements, render the source of supply certain and therefore of the first importance for irrigation requirements. It is in such countries that the lands can be irrigated to the highest state of perfection, and that such is actually the case may be inferred from the fact that in the neighbourhood of Cairo agricultural holdings when put up for sale fetch as much as £150 per acre. In Italy, and in India as well, the source of supply is for all practical purposes unlimited, and this, combined with highly favourable physical conditions for the storage of water and its diversion for economic purposes, renders irrigation possible on such elaborate and extensive scales as in other less favoured countries would not be feasible. In the former country the great rivers and lakes whose precious waters have so wide a fertilising influence on the thirsty plains of Piedmont and Lombardy are fed by the Alpine glaciers and melting snows that have accumulated for ages on the lofty mountain ranges to the north. And the mighty streams of India, rendered famous from time immemorial, are no less remarkable for the immense volumes of water that are brought down in flood seasons from the stupendous Himalayan chain, whose perpetually snow-clad and glaciated summits are inexhaustible feeders of the vast drainage systems which spread themselves out in all directions like a network over wide territorial areas. From these a never-failing supply is derived, supplemented as it is by the copious tropical rains that fall in torrents over the foothills and slopes of the lofty ranges in which the rivers have their origin. And these are actual geographical conditions, which must not be overlooked, for their importance can scarcely fail to leave an impression on the thoughtful mind, to such an extent as to arrest attention and induce consideration,

especially by all whose duty it is to contemplate the subject of water conservation for irrigation purposes or other industrial needs. They point conclusively to the fact that for any system involving the extensive economic use of water the countries under reference are immeasurably superior to the Australian Continent, considered as a whole. And even if we go to America similar conditions exist. In summarising the results of a recent tour round the world in 1903, I had occasion to allude somewhat briefly to this same subject, and, as my views since then have undergone no change, it may be convenient to restate them in so far as they refer to the New World: "In America . . . we meet with vast mountain systems that spread themselves out in all directions over the whole Continent, greatly influencing the climate and materially affecting the conditions of settlement. For many months of the year these lofty regions are covered with snow, which, melting by the heat of a mid-summer sun, gives rise to numerous rivers, whose permanent waters, flowing in winding channels over vast lowland tracts, are a never-failing source of supply to such industrial systems as have for their object the reclamation of arid lands. Suspended on the troubled waters of these mighty streams are the sediments of disintegrated rocks and soils, whose fertilising influence upon the alluvial areas of river valleys has been recognised from time immemorial. The physical structure of the country also lends itself readily to the impounding of these waters and to the construction of service canals for irrigating large agricultural areas. These conditions, then, obviate the necessity for depending upon an uncertain and irregular rainfall, as well as for the construction of vast storage reservoirs, whose exposed waters under the influence of an extremely dry and hot climate would constantly diminish by evaporation and in times of drought probably disappear altogether. They also contribute greatly to the financial success of irrigation systems by facilitating the work of construction and rendering more permanent such undertakings when complete. And it may also be added that the natural surface grade of much of the arid lands of the country is such as to greatly facilitate the distribution of water over immense areas. From the preceding remarks it will be seen that the source of supply is practically unlimited, which must necessarily contribute in a considerable measure to the success of irrigation in the United States of America. Many of the rivers are fed by the melting snows that must always remain a permanent feature of the high mountain ranges there, whilst other streams traversing warmer regions are loaded with the waters of copious rainfalls. These conditions are mostly absent in the interior of Australia, where the rainfall is so irregular and uncertain. In the coastal districts of the Australian Continent the rivers are, as a rule, short and rapid. And in the inland regions the streams carry very little water except in times of flood, and their channels are not usually suitable for the purpose of large storage reservoirs. In the basin of the Murray River and its tributaries the conditions are somewhat different, and altogether more favourable for the irrigation of extensive areas. The melting snow of the great Alpine cluster of rugged mountains in which the river has its source contributes largely to the permanency of

that important stream and affluents, from which a never-failing supply of good water could be obtained for reclaiming the arid lands of the valley below."

Now, in as brief a manner as possible I have endeavoured to contrast the irrigation conditions obtaining in Europe, Asia, and America with those in the Australian Continent, and to show how vastly the former differ from the latter. In point of fact the difference is for all practical purposes as wide as the hemispheres in which they occur, and the realisation of this is only rendered possible to the mind familiar with the physical geography of the world and its important bearing on the economic life of the entire globe. And touching upon this phase of the subject suggests to me the necessity for striking a warning note and of pleading for a purely local consideration of the matter under discussion. Why should we not strike out on original lines and evolve something distinctively Australian in character, suitable to the requirements of the country? It is at once admitted that the American irrigation works are bold and progressive; that in Italy a high-class system of water control has been evolved through generations of experience; and that in India the conservation and utilisation of water is carried out on a large scale, to the manifest advantage of the Empire. But it would be the height of folly to attempt anything of the kind on similar lines in Australia, and no man with a mature and comprehensive knowledge of the wide geographical conditions of the continent would think of advocating or approving of such. In point of fact my personal investigations have convinced me that no human enterprise can possibly establish any system or systems of water conservation in Australia to compare in magnitude with works of the kind in the countries to which I have alluded, and that any attempt at imitation will prove a failure. Indeed it seems perfectly clear to my mind that the failure of the Mildura scheme in Victoria was in no small measure due to too much of the American idea and too little of Australian experience, combined with inadequate geographical knowledge. This, then, suggests to me the necessity of urging that the subject be considered in all its essential bearings from the *local standpoint*. And such consideration must be based upon purely geographical and professional data, without reliance upon the experience of other countries at all.

Now, in sounding a warning note, so to speak, against the folly of undertaking gigantic irrigation projects in this country with the idea of following the example of America, say, or India, it must not be understood for a moment that water conservation is impracticable in Australia. As a matter of fact the case is quite the reverse, for not only is it possible and feasible to store vast quantities of water for irrigating small agricultural areas and fruit plantations along the continental seaboard, but all the coastal districts possess more or less adequate facilities for water storage, and in the basin of the Murray River and tributary streams the conditions are eminently favourable for extensive irrigation works. But there are few other places about which so much can be said. Still, no animal should ever be allowed to perish from thirst, while there exist ample means for conserving a portion of the rainfall that annually runs to waste,

and no arid lands should find a place on the map where they can be watered and profitably utilised. As a matter of fact the losses sustained through the death of stock during periods of drought are infinitely greater than would be the outlay for preventive measures in the shape of adequate systems for the conservation of water. And in this respect I may say at once that I entirely disagree with those who hold that it is not possible to make any provision to minimise or prevent such losses.

We are told that from 1895 to the end of 1900 there have been lost in the State of New South Wales alone some "twenty-five millions of sheep by starvation, in addition to the death of all the natural increase during a period of six years, which in good seasons would have amounted to about twenty millions of sheep more." Now, taking the average price of each sheep as, say 7s., this would mean an actual loss to the State of over fifteen million pounds sterling, within the time specified, which would more than cover the cost of storing an adequate supply of water in all the pastoral districts of the State and leave an ample margin for working expenses. And the same may indeed be said of all the other States of the Commonwealth, where the losses in stock during prolonged droughts are enormous. It is not for a moment contended that there should be a widely extended and progressive movement having for its main object the irrigation of pastoral holdings throughout Australia. But there is no reason why there should not be developed a system of water conservation sufficient for the requirements of starving stock in times of prolonged drought, so as to prevent disastrous loss and obviate the necessity of importing our local meat supply at such periods, and afterwards restocking the whole of the country at great expense and hindrance to trade. In the arid regions of the New World it is not uncommon to grow food for stock on irrigated lands, and numerous fields of Japanese clover, met with in travelling recently through America, afforded sufficient evidence of the success of the industry. It is usual to take four crops a year of this drought-resisting fodder plant off those specially fertilised areas, the yield being from six to eight tons per acre, and there is no reason why similar results should not be obtained in this country, where the soil and climate are even superior. Then there are the agricultural interests of the State to be considered, and these are of wide and far-reaching importance. And in this connection it is necessary to pause and think how much better it would be for all concerned if Australia were in the same position as, say, California, with her splendid fruit supply, and other products of systematically irrigated lands. Nor is it possible to overlook the important bearing of such matters on the industrial life and general prosperity of the entire Commonwealth, which must acutely feel the injurious influences of recurring disastrous droughts, so long as no provision is made to minimise their widely felt effects.

There is no doubt at all that a great deal of the agricultural lands lying within the coastal districts of New South Wales and Queensland could be fertilised very considerably by conserving a portion of the rainfall that now finds its way through numerous river channels to the sea, and is entirely lost to the country which so much needs it. It is not for

a moment supposed that this idea of water conservation is applicable to every stream along the whole seaboard of these States, as there are places where, from my own personal knowledge, the local physical conditions would render the establishment of storage works out of the question. But on the other hand it is known that some of the streams afford good facilities for impounding water, and these should be fully utilised. And, indeed, the same may be said of most of the coastal districts of Australia, where lands are suitable for agriculture. Besides the Murrumbidgee there are in New South Wales the Murray and Lachlan rivers, both of which afford important facilities for the storage of water on a large scale, the former being without doubt the greatest of all our antipodean streams, from the economic standpoint, although it is of comparatively little value as a means of direct communication between the sea and the interior, in consequence of an obstructed outlet.

In Queensland there are several coastal rivers whose waters would be of immense advantage to the industrial life of the State if systematically conserved and economically utilised for the irrigation of agricultural areas and the watering of stock during abnormally dry seasons. The great drawback with some of our Australian rivers is insufficiency of water. In flood times the supply is greatly in excess of the demand, but during protracted droughts the streams fall very low and could probably not be depended on for extensive irrigation. Still in many of the more permanent channels immense volumes of water are allowed to run to waste yearly, instead of being used to fertilise the lands where they are so greatly needed, or to keep alive the vast numbers of sheep and cattle that perish from thirst.

The first step in the direction of water conservation is to systematically gauge the rivers, explore their basins, and locate suitable dam sites. And as this is the work of years, no time should be lost in making a start, for it is necessary that the discharge of the streams should be known in seasons of least rainfall as well as during times of flood, so as to ascertain the minimum quantity of water available for industrial purposes.

As the work involved will necessarily be expensive, and some time must elapse before any return on the outlay could be expected, I would suggest the establishment of a water-rate to be levied on all property-holders who may reasonably be expected to benefit by the storage of water, and that the revenue derived from such rate be set apart exclusively for the purpose of having all our promising or likely rivers thoroughly explored hydrographically and a system of gauging established with the view of instituting irrigation works in suitable localities, where the water supply is found to be adequate. And this can only be ascertained by detailed examination of available data, such, for example, as rainfall, the loss occasioned by evaporation, and other causes, the physical condition of the catchment areas and of the channels. But the work of obtaining this information should be put in hand at once, as it will take many years of patient and careful labour to collate sufficient reliable workable material for the establishment of any extensive system of irrigation. The professional men now employed in the State could

do all that is necessary in this matter, as expert service would not be required for a long time to come, when all the preliminary investigations would be mature and the required data available for special treatment.

For irrigation to be successful in Australia, or elsewhere for that matter, the water should be under direct State control, and the whole enterprise of distribution and utilisation, if in the hands of the Government, should be conducted on strictly business lines. The initial expense of introducing irrigation into a country is usually great, and as a rule there must necessarily be some time of unprofitable labour in preparing the lands for cultivation. Then there is the difficulty and delay involved in settling people on the areas to be watered, and many obstacles to be overcome before there can be any adequate return on the original outlay. But, on the whole, it is desirable that the system of co-operation should form the basis of any movement for the reclamation of arid lands. There is, for instance, nothing better than the results achieved by the Mormons, whose co-operative system in the State of Utah is a monumental example of a magnitude unequalled elsewhere. And this illustration, combined with other less notable though equally successful experiences, suggests the recommendation that all industrial undertakings of the kind should be carried out by private enterprise, the water supply alone being provided by the State, on payment of a fixed scale of charges.

There is no doubt whatever that a great future lies before the Commonwealth, if practical steps be taken to conserve water, to reclaim the waste tracts of the inland districts, and to render more fertile and profitable some of the poorer agricultural areas of the coastal regions. The effects of such an enlightened policy on the part of the authorities would do more to encourage private enterprise; to bring about a lasting prosperity to the country at large; to settle people on the land, thereby increasing the rural population; to restore the confidence of investors, and pave the way for successful immigration, than anything that has ever happened since the discovery of gold and the establishment of representative Government. This is a bold statement, but to those who have studied the history of settlement and colonisation during the last two or three hundred years in other parts of the world it will seem perfectly justified and reasonable. On the other hand, the States will never develop extensively and be so progressive as they ought to be while there is neglect of this important matter. Those engaged in the pastoral and agricultural industries upon which the prosperity of the country so much depends, become dispirited by the disastrous effects of recurring droughts, and in time the whole of the Commonwealth acquires an evil reputation, which spreads far and wide, doing much harm to the best interests of rural settlement and retarding colonising enterprise in many ways. And this in point of fact is a condition which may be said to apply to all parts of the Continent where the rainfall is inadequate and irregular.

In conclusion, the commercial or business side of the subject may fairly claim some slight attention. Viewed in the light of past Australian

experience it cannot be said that the prospects in this direction are remarkably bright. But that is all the more reason why every effort should be put forth to make the Northern Murrumbidgee irrigation scheme successful. We must profit by the failures of our neighbours, and indeed by other failures as well, and learn by experience how to avoid the pitfalls that usually lie before those who set out on new enterprises. The initial stages are mostly difficult to overcome in all pioneering undertakings. And in this particular undertaking there is almost sure to be some delay in getting the right sort of settlers to take up the land to be irrigated. But once the great advantages of the scheme become widely known there will be fewer obstacles in the way and less cause for anxiety as to future success. There is one thing certain, that a step in the right direction has been taken, for the country will always labour under great disadvantages so long as there is no effort made to reclaim the waste lands of the western district and to minimise the effects of drought by the conservation of water.

THE TOPOGRAPHY, HISTORY, AND ECONOMICS OF JERUSALEM.[1]

THIS great book presents many sides to the world, and on every one of them it is indeed a great book. As a geographer and historian, Professor Smith has already established a world-wide reputation by his *Historical Geography of the Holy Land* and other writings. For him the two lines are blended, and the geographical study of a land has in it necessarily and always what he has himself so happily termed "the sound of running history." The writer can recall certain well-remembered days when, on more than one hill-top among these very scenes, he watched the Professor as he lay down with map outspread, and swept the horizon or fixed his gaze upon some selected point in silence. Then, with a shout, he would spring up, and explain the landscape, until the swirl of history was all around and below the hill, and the contours of the land had given up their secret. His eye and instinct for the essential geography of a region are unique, and his point of view is ever that of a general marching troops, arranging for their supplies, or working towards an occupation or a siege. From the earliest chapters of the Topography you perceive that he is preparing for war, and by the time that you have ended the second volume you have fought over the principal battle-fields of some 1500 years.

Yet the genius of the book is many sided. In the chapters dealing with the names of Jerusalem we find, as we would expect, the thoroughness of the expert in Oriental language and literature. But there is the same free movement and sure step in other lines. The geology, the

[1] *Jerusalem, From the Earliest Times to A.D. 70.* By George Adam Smith, D.D., LL.D. In two volumes. London: Hodder and Stoughton, 1908. *Price* 24*s. net.*

economics, the endless detail of human interest and occupation which astonish us as we proceed, all inspire the same confidence, as of one who will not write the thing he does not know. The fulness and thoroughness of the work is attested by the altogether amazing extent of the Bibliography, and we are specially grateful for those selections from the relevant literature inserted for the use of students in the earlier parts of many chapters. The spade-work is beyond all praise for its unwearying patience and thoroughness, and the reasonings and generalisations from it are correspondingly clear and clean-cut in a region where those qualities are difficult to attain.

A notable feature is the use of the methods and results of the higher criticism. One perceives in these volumes the advances that recent years have made in this department. Not until now would such a book have been possible, when the gains are becoming manifest, and the line between speculation and ascertained knowledge is being defined. Professor Smith's use of this science is careful and temperate, yet full of well-grounded conviction. He knows and utilises all the results of scholarship up to the very hour of writing, yet he maintains his independence and forms his own conclusions. Of the higher criticism this book gives us as valuable an exposition as has appeared in print, and, if we may select one among many memorable instances, the lucid and most interesting account of Deuteronomy (vol. ii. chap. viii.) is particularly valuable. The author has shown, perhaps more clearly than this has ever yet been shown, how powerful an instrument these newer methods of dealing with the sacred writings may be, not only for historical but for religious and devotional ends. The fact of divine revelation, transferred from the region of mere penmanship back to the stage of history, where God appears, not in words only but in deeds, becomes tenfold more wonderful and commanding. "A code like the Book of Deuteronomy was not brought forth at a stroke, but was the expression of the gradual results of the age-long working of the Spirit of the Living God in the hearts of His people."

The style is, on the whole, more tense than in his former work, and the choice of the exact word or metaphor as characteristic as ever. Brilliant and daring phrases, as surprising as they are illuminative, light up the pages of this as of his other books. Solomon's personality is hidden from us "through lack of that atmosphere of adversity which alone reveals a man to his contemporaries and posterity"; the key to the history of the city is the "conspiracy between its people and the free, wild desert at their gates." Similarly, unnoticed passages of Scripture stand out in new and sudden significance, as we find them interpreted for us by geographical or other physical phenomena, such as wind or earthquake.[1] Again, such physical phenomena pass over into the religious thought of the nation and gain immortality from the new spiritual significance thus attached to them.[2]

But above all other qualities of the book, and enriching them all, is

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[1] Cf. vol. i. 12, 20, 24, 67, 104, 206, 454; vol. ii. 128 *et seq.*

[2] Cf. "Waters," i. 133; "Zion," i. 146; "Hinnom," i. 174 *et seq.*

that splendid and inexhaustible human sympathy which is everywhere in evidence. We are constantly delighted with the generosity of his appreciation of the work of other workers. The personal touch and presence of the writer are never obtruded, but they are always with us in that large-hearted companionableness which even readers who have never seen him know and prize. Part at least of his power of writing so vividly the history of men dead very long ago, and certainly part of his power of handling accurately and adequately so many-sided a subject, is this same human sympathy. To quote but one instance—and it is perhaps as striking an example as we have ever met with—the long and patient account of the waters of Jerusalem closes with a couple of pages which reveal behind the ruins of aqueducts and the fragments of ancient cisterns the eager struggling forms of men working for these waters as for life. "We cannot have worked through this series of water-systems without a vivid imagination of the secular, ceaseless labours which produced them, or devoid of a profound sympathy with the hopes which their meagre results excited in the hearts of their authors."

Such a book depends for much of its practical value upon its index, and the various indices of these volumes are, like that of the *Historical Geography*, the work of the author's wife. The labour involved in their compilation must have been enormous, but the result well repays it. For their judiciousness of selection, their minute accuracy of detail, and their extraordinary completeness of reference, it may be hoped in the interests of scholars and of general readers also that these indices will set a type for all such books in future.

The volumes are copiously illustrated by beautifully executed maps, the work of Mr. J. G. Bartholomew, and by fine reproductions of photographs, which have done much to enhance the value of the letterpress.

The first volume begins with the Book entitled *Topography*; but there is first a general introduction, under the name of *The Essential City*. In this we see that inclined plane of buildings tilting its surface downward and eastward to the Kidron Valley. Night falls, removing the aggressive detail of the modern city, and revealing the ancient "bride of kings and mother of prophets," the city of "the rock, the olive, and the desert," which has been the scene of so much human strife, upon whom "the passions of mankind were let loose," and the scene also of "that more mysterious and awful contest between the spirit of God and the spirit of man." We see her surrounding blockade of hills, broken only by the one south-eastern ravine that leads the desert to her gates and binds her over to the east. We note the wanderers from many lands drifting about in her streets; the water supply, secured with much travail for herself, but withdrawn from her besiegers; the occasional touches of natural magic breaking the usual aspect of plain bareness, which, however, has also its own significance in history.

Then we proceed to the task of investigating those heart-breaking accumulations of shot rubbish as we search for nameless fragments of ancient building; for the building of the city is stratified and its fragments mingled as is also the literature of her great book. Before we

have finished these volumes we shall see much of that confusion yield to patient and determined search.

The *Site of the City* first reveals to us a position a little to the east of the main ridge of the Judæan range, closed from expansion or attack by steep ravines, except on the north and west. The present buildings fall away, and we see two lines of hill, like the thumb and forefinger of a hand, with a clearly hollowed valley between them. These are the East and West Hills, and the famous Tyropœan; and on them the ancient city gathers itself in different contours from anything that now we see.

Geology is discussed, mainly with a view to the all-important question of water supply. The surface rock is porous, lying on an impervious bed on which the water accumulates and flows. Those keen eyes of the author have noted everything. He sees what stones "weep" with percolating streams, what fountains are brackish from contamination, what soft stone will harden, and what will disintegrate with weathering.

After a delightful chapter upon *Earthquakes, Springs, and Dragons*, which the ancient name of the Dragon Spring has suggested, we come to the question of the waters. The mythological connection of dragons with earthquakes and underground springs adds a very picturesque touch to the survey, and the insistence, here and elsewhere, on the probable agency of earthquakes in modifying the flow of waters, opens an interesting field of scientific inquiry and discussion.

In the *Waters of Jerusalem* the author settles down to the serious work of exploration, tracing every known fragment of aqueduct, pool, or conduit, and focussing his investigations at the one permanent and critical point, the Virgin's Spring, or *Gihon*, with the famous tunnel of Hezekiah, which conveyed its waters to Siloam within the walls.

Having thus founded the city upon the floods, he proceeds to the identification of the three main lines of wall which, at various periods, were thrown round it. This is the crux of the whole investigation. The first wall was that of the most ancient kings, the second dates from Hezekiah's time, and the third was built by Agrippa. The first and third do not present such difficulties, nor are they of such importance, as the second, which was the line of wall in the time of Jesus. The former tests, drawn from style of masonry and stone-dressing, have now to be abandoned, owing to the imitation by one age of the work of other ages; and we are thrown back upon a vast mass of evidence, historical and archæological, which is patiently and with astonishing thoroughness sifted and weighed. In this chapter we "walk about Zion" with a vengeance, for it is no light thing to perform that walk under the conduct of so strenuous and so urgent a guide. Yet the interest is sustained. There is no confusion, nor any loss of continuity. In that field of wreckage, which we cross and recross so often from our base at the Tower of Pharaoh, the wonder is that anything can be identified at all. But, as we become acquainted with the work of Bliss, Guthe, and other explorers, we gain at least a general idea of how each wall in succession ran, and follow the expansion of the city towards the west and north with more comprehension than we had hoped for. The

northern line of the second wall baffles this careful and dispassionate investigator, who refuses to be tempted by attractive and picturesque results based on insufficient data; and with the surrender of that line goes the possibility of identifying the site of Calvary, about which so much eager controversy has been waged. It is not too much to predict that this chapter will form a sort of centre of reference and a starting-point for all succeeding work upon its subject.

Among the identifications regarded as certain are "The Virgin's Spring" (which is identified with Gihon, and probably with Bethesda), Hezekiah's tunnel, the Valleys of Hinnom, Kidron, and the Tyropœan, and the threshing-floor of Araunah in the Haram area. All these sites and many others hang together; so that on the identification of one much of the evidence for that of others depends. But by far the most important of them all is the identification of Zion with the City of David upon Ophel—the Eastern, and not (as has been popularly believed since Josephus) the Western Hill. The evidence for this appears to be conclusive, and it is set forth in a long and lucid chapter.

The Second Book deals with Economics and Politics, and throws much light upon the questions of food supply, tenure of land, taxation, natural resources, and commerce, in view of the facts of steadily increasing centralisation of national life in the city caused largely by the requirements of her dominating shrine. The natural resources are mainly summed up in "the great triad of the olive, the vine, and the fig." No wheat is grown in the immediate vicinity of the city, nor any great supply of timber trees. Salt has to come from the Dead Sea, and sheep and goats from hills at a distance from the walls. Evidently the surplus of such a meagre store of native supplies would hardly afford purchasing power sufficient to make up the city's defects in respect of other necessaries. But crafts sprang up in Jerusalem, in her royal days, at the demand of her kings. Commerce touched her from the great roads which passed at no very great distance from her gates. Royal revenues of various kinds, and Temple revenues, supplemented these and greatly enriched her. The latter source of wealth is perhaps the most interesting from a historic point of view. The Temple, besides its revenues drawn from the worshippers to pay for the upkeep of the large and increasing company of its ministers, served also as a bank in which great stores of money and negociable assets were laid up, lent upon occasion to a needy king, or paid as tribute to a conqueror. Thus, in addition to its more sacred functions, the Temple served as a centre of trade and of finance. For manufacture and industry the city was never conspicuous. As the wealth and energy of the country were drawn to the capital, no doubt there would be many native craftsmen who profited by these; but Jewish industry was subject to hampering restrictions imposed by the religion as well as by the position of the city, and most of it was generally in the hands of foreigners.

A strong chapter traces the development of the Government from the days of royal absolutism through the changing forms that led up at last to the almost equally absolute power of the Sanhedrin. Two dominant facts give their significance to this development. First, is the steady

trend of power away from the secular to the religious authorities; second, the ever underlying and essential democratic character of the nation. The latter of these leads up to one of the most memorable chapters in the book, that on *The Multitude*. It is a wonderful picture, like that which Jusserand has given us of the "rustling crowds" of Chaucer's England, but far more charged with political and religious significance, and far more clearly seen as a social unity. This "restless and ominous background" to the history has its origins far back in that force of public opinion which is behind the will of the nomad sheikh. The prophets gave it a religious sanction, but it grew more and more away from religion towards political faction, although to the end it could easily be roused by religious cries. Sensitive to eloquence and fickle as the wind, jealous for the national law and for national freedom; whether surrounded by Roman government and Greek thought, or confronted by the Great Prophet of Nazareth; it presents as fascinating a picture of human nature as one may see in a lifetime.

In the second volume, Book III. recounts the history of Jerusalem from earliest times to the siege of Titus. This is the more popular volume, yet it never hesitates to pause upon a difficult problem and face it with all the thoroughness of the more technical chapters of the topographical section. The whole volume reads like a romance, one had almost said. Yet not like a romance, but like a piece of living history, which is far better. From the general story of the nation such selections are made as keep light playing from all sides upon Jerusalem. Under our eyes the city grows up and spreads, and we almost hear the chisels of its builders. Here as before, the human interest is sustained and dominant. At intervals the narrative breaks into a personal portrait which sets one more of the ancient dead, living and immortal in the imagination of the reader. David, Solomon (hardly visible behind his own glory), Isaiah, Nehemiah, Herod—many another figure, indeed, but these above all the rest—are painted for us so that we shall know them henceforth better than we know most of our contemporaries. And from time to time a corresponding view of the city is given—David's Jerusalem, compact upon the East Hill, dim and misty on the West, fresh from the hands of that tribe of Semites, the Jebusites; Athaliah's Jerusalem with its Phœnician foreigners; Isaiah's "boisterous city"; Nehemiah's, burned and ruined. As we pass from period to period, the view of Jerusalem fades and grows clearer again with the advance of the narrative. The frontier of Judah on the north swings to and fro with the fortunes of the city. Fortresses rise and are thrown down again. Men alternately quake and are filled with boastfulness and shoutings. Now a "grisly thing," the relic of the ancient heathenism, has to be cut down: again the broad platform of the Temple offers too good an opportunity for the worship of the host of heaven. Josiah establishes monotheism upon the basis of Deuteronomic law; in Ezra's and Nehemiah's time the priestly code throws its new fence of law around the conscience of the nation, and its new fence of stone around the city's homes. Invasion, panic, exile, restoration—so the great story, greatly told, moves on. At last we reach, in one of the finest of the

chapters, the contact of Jew and Greek, and the brilliant effects and violent reactions of that contact. The author of Ecclesiastes stands up before us, alive and experienced in all the ways of men, and delivers his verses, now translated freshly and musically into a new tongue. At last we reach the Romans and Herod. Pompey enters the empty Temple-shrine, an awestruck victor; and Herod's unscrupulous and audacious brilliance casts its unwelcome splendour over the evening of the city's life.

We regret that space does not permit us to treat this section in more detail, for Volume II. is a very powerful achievement in history and a very choice one in literature. But one thing more must be said. Throughout the whole story, from David's Ark to Herod's Temple, the centre of the drama is ever the religious life that gathered round the shrine on the Eastern Hill. In Solomon's time it was but the highest and most conspicuous of a mass of palace buildings, and it was but one of many shrines permitted throughout the land. From that time onwards, in spite of many vicissitudes of destruction and restoration, we see it steadily advancing in importance as a factor in the national life. It flings off the other buildings from the wide precinct; it flings off the rival secular power, and Zerubbabel disappears; it has already, before this last event, flung off the other holy places of the land, and become not chief but sole sanctuary of Jehovah. Much arrogance accompanies the advance, but also much permanent progress in religious thought and faith, for "the Temple was the approach of a nation to their God."

Yet, from first to last, the approach is incomplete. The spiritual needs of man are essentially personal, and they cannot be met by the best of Institutions, but only by a Person. For a thousand years the Institution had done its best to meet the needs, but the better they were understood the less was such satisfaction possible. The cry of Jerusalem and of mankind was for the Lord of the Temple, and at last He came. The Love of God, incarnate in One who "has come to share the ethical warfare and passion of men," arrives in Jesus Christ; and the writer of the Apocalypse, in his vision of the New Jerusalem, sees no Temple therein, for the Lamb is the Temple of it.

All this, in minute and full detail, is the burden of the greatest chapter of the book, *The Temple and the Lord*, to which all other chapters lead up, and in which they culminate. History has sometimes spoken lightly of Theology, and even scorned her. Here is a chapter in which Theology comes to the aid of History, giving to her the only possible interpretation of herself, and glorifying her with divine meanings which she herself had never guessed. It is one of the most conspicuous and original contributions to Christian thought that have been made in modern times, and its far-reaching significance will be appreciated only the more fully as it grows more familiar, and binds the history, not of Jerusalem only, nor of Israel, but of mankind, into a unity of progress towards "one far-off divine event."

Of course these volumes have not said the last word on their subject; but, if we mistake not, they will be used as a starting-point by future investigators on many questions, and as the final statement of many others.

JOHN KELMAN.

DISTRIBUTION OF PLANTS IN CHILE.[1]

THE vegetation of Chile has been investigated from time to time by a number of distinguished botanists, and is now better known than that of any country in South America. Although portions of the country still remain to be explored, Chile as a whole, in regard to natural history, has passed beyond the stage of the explorer's diary such as Darwin's notes during the voyage of the *Beagle*. The author of the memoir now under consideration aims at an exhaustive analysis of the flora and plant associations, their present distribution and history. Dr. Reiche has been a prominent resident botanist in Chile since 1890, and his position as chief of the botanical department of the National Museum at Santiago has given him great opportunities for collecting the necessary information.

The history of botanical observation in Chile opens with the arrival of Fernando de Magallanes in October 1520, at the entrance to the straits which now bear his name. On his first landing, he found a shrub which gave off a sweet-smelling smoke, and mentions that this, with a kind of water-cress and an herb like parsley, were useful vegetables for recruiting the health of his scurvy-stricken crews. This shrub is now known as *Drimys Winteri*, the specific name reminding us of Winter, captain of the *Elizabeth*, one of Drake's fleet in 1577. The opening chapter of Dr. Reiche's book follows the historical development of botanical exploration in Chile, but in reality its scope is much wider, and extends over geographical and economic evolution. The advance of knowledge begins with the early vague records of sailors who touched the coast here and there, and the Spaniards marching overland through the mountain passes in the course of their invasions. Two main phases can be distinguished: an earlier period of casual observations and descriptions, the notes of voyagers; a later period beginning about the middle of the eighteenth century marked by the activity of the trained botanist whose main object was investigation of the flora. As milestones in this later progress the author mentions Molina, the first naturalist writer of Chilian nationality; the expedition of Ruiz and Pavon (1777-1788), the first strictly botanical expedition; the period of South Sea voyages in the early part of the nineteenth century; the naturalist, Claude Gay, and his encyclopedic activity on the lines of Humboldt and Cuvier; the much more detailed labours of R. A. and F. Phillipi, and the still later investigations of the German school which one may connect with the name of Karl Reiche. The evolution is typical of the advance of scientific knowledge in so many other countries. Molina (1739-1829) was a Chilian Jesuit priest much persecuted because of his progressiveness, and ultimately obliged to carry the results of his labours to Italy, where he published his *Saggio*, which, in spite of its many faults, was for a long period the only source of information on a land hardly known. The

[1] *Grundzüge der Pflanzenverbreitung in Chile*. By Dr. Karl Reiche. (*Die Vegetation der Erde*, Part viii.) Engelmann, Leipzig, 1907. Price 30 *m*.

period of hazardous voyages and explorations which followed brought its scraps of observation and collections, and the names of many a traveller can be recognised in the names of Chilian plants—Dombey, Freycinet, Caldcleuch, Miers, Bertero, Cumming, Gillies, D'Orbigny, Kittlitz, Weddel, and many another. All these fragments were brought together by Claude Gay (1800-1873), of French birth, who studied in Paris under Cuvier, Desfontaines and Ad. de Jussieu, and after wandering in the Alps, Greece and Asia Minor ultimately landed in 1828 in Valparaiso to take up the duties of a schoolmaster. In 1830 a happy chance placed Gay at the head of a movement to explore Chile and describe it. After a period of exploration, collecting and recording, Gay carried his material to Paris and distributed it amongst a number of co-workers. He ultimately edited the great memoir *Historia fisica y politica de Chile*, in 26 volumes—Zoology 8, Botany 8, History 6, Agriculture 2, Documents 2, and an Atlas of 313 maps. The state organisation which enabled Gay to do all this was the result of a decree of President Ramon Freire in 1823. The young republic had just then thrown off the Spanish yoke, and was ambitious to see actually what kind of possession it had secured, for many parts had scarcely been explored. Lavaysse, a Frenchman, more sea-rover and pirate than naturalist, was the first Director of the Natural History Museum, the project of the famous President O'Higgins. The ambitious scheme soon came to an unhappy end under such guidance, and Gay's task was none the easier since he had to gather up the wreckage and re-establish confidence. In forty years Gay more than accomplished what at its first inception looks almost absurdly quixotic, and more like political bombast than a sane scientific project. The *Historia fisica* may be said to end the romantic period of Chilian natural history. What follows is strongly German in character ; on every possible opportunity naturalists have accompanied exploring parties. Dr. Reiche himself has made many journeys, and so accumulated observations and material for the National Museum, which now ranks along with the natural history museums and herbaria of much older countries. The bibliography of the Chilian flora extends to over 500 titles, and includes a large proportion of monographs on genera, the description of new species, the compilation of a flora, all proceeding on the same lines as at Berlin, Dresden, Paris and Kew. This is the environment from which Dr. Reiche's memoir has come. While these conditions ensure scientific accuracy, they have their drawbacks, and one frequently finds it difficult to disentangle important conclusions from the mass of detail and cautious reservation. This is to be regretted since Dr. Reiche's careful studies make his views more valuable than the hastily formed opinions of writers who, with less knowledge, state their views with more confidence.

The distribution of plants in Chile is not yet fully known. The provinces of Santiago, Valparaiso, Maule, Concepcion, Valdivia, the Magellan area and Juan Fernandez have been explored most thoroughly ; on the other hand most of the islands off the coast of West Patagonia are almost unknown, while many tracts of the desert parts have been only superficially examined. The varied topography and the widely

varying climatic and soil conditions make the distribution of plants somewhat complex, but on the other hand almost every extreme form of vegetation can be met. The author presents only the main facts of the physical geography and climate in two short chapters, so that the reader must supplement by reference to other works. The principal climatic regions are those proposed some years ago by Aldana from the agricultural point of view :—

I. Tropical provinces : Tacna, Tarapaca, Antofagasta and Atacama ; climate tropical to subtropical, dry, rain very rare in the western part, but summer thunderstorms occur in the north-east ; portions of the coast and the valleys extending inwards are kept more uniformly moist by the "Camanchaca," a sea-fog. The daily range of temperature in the interior is extreme, and the seasons are not distinctly differentiated. The greater part of this region is desert, and trees and cultivated land only occur in the natural oases and along a few river-courses.

II. Subtropical provinces : Coquimbo and Santiago southward to Concepcion. Rain falls in winter, May to August, and a dry season is sharply defined from a rainy one. The rainfall increases southwards, and the daily range of temperature becomes less marked, especially in the lowlands. Forests become more extensive towards the south. Cultivation can be carried on in the interior down to about 37° S. with the help of irrigation, but nearer the coast the atmospheric precipitation is sufficient. The floral year in the central province round Santiago begins after the autumn rains in May, and the mountain slopes become green. No great wealth of flowers occurs till the months September to November ; after this it diminishes towards autumn. Herbaceous plants and grasses wither so quickly, however, that the delicate green of the hills becomes a dull yellow during December. The magical poetic season of spring we are told is not in Chile what it is in Europe, the awakening of vegetation from a flowerless winter to a gay summer, because even in winter, in July, many plants are still in flower.

III. Southern provinces : Arauco and Valdivia southwards, including the archipelagoes off the west coast and Terra del Fuego. The climate is rainy at all seasons, with frequent storms. The rains are heavier along the coast, and there is little distinction of seasons ; sometimes little or no rain may fall for several weeks, but in other years rain and storm hardly cease even in summer. The inland part increases in dryness towards the east, and with this the contrast between hot summers and cold winters becomes more marked. Forest prevails on the coast but diminishes inland, giving place to grassy "Pampas" which provide grazing grounds along the valleys and on the foothills.

These three groups of provinces are adopted as phytogeographical regions, as suggested by J. Ball in his *Notes of a Naturalist*, so that Chile is divided into a northern (18° S. to 30·5° S.), a central (36° S.), and a southern region. Each region is again divisible into a coast portion and an inland one, and the presence of the long fertile rift-valley from 33° S. to 41° S. dividing the coast ranges from the main mass of the Andes furnishes another base-line for further subdivisions.

The description of the vegetation is carried out from various stand-

points (pp. 63-160). An excellent series of photographs, showing important plants in their natural surroundings, enables the reader to become familiar with the more important plants, the very names of which are strange to the naturalist of northern temperate lands. These also include portions of the landscape. Amongst life-forms of plants, columnar and globular Cacti, often of huge size, are conspicuous in the drier mountains. Tussock plants are another feature of the landscape; many species assume this habit, compact cushions of hard leaves standing isolated and conspicuous over desert areas or where a grass sward is present during a few months only. The author regards the tussock as evidence of unrestricted growth in all directions under conditions which do not favour lateral extension, the new shoots appearing close to the edge of the parent cushion. The various plant formations are grouped as mesophytic and xerophytic, the hygrophytic or wet types being poorly represented. The mesophytic or moist forest begins in the central region (31° S.), and evergreen trees predominate in the north and throughout the provinces of Aconcagua and Santiago and over the foothills of the Andes to about 35° S. This constitutes the temperate rain forest, distinguished by considerable variety in the trees and a dense undergrowth which includes lianes and epiphytes. Another forest type, the cold temperate summer forest, consists mainly of deciduous trees with an open canopy favouring a ground vegetation, with many brightly-coloured plants. This begins on the mountains about 36° S. and extends southwards over the mountainous parts of the Magellan area. Passing still further south into the rainy climate of Tierra del Fuego, the evergreen forest again prevails, made up chiefly of the Antarctic Beech (*Nothofagus*). The evergreen leaf is in the author's opinion the outcome of uniform conditions, whether these be found in the subtropical parts of Central Chile or in the uniformly rainy region of the extreme south. On the other hand, the climate with wide variations between dry and moist or between hot and cold, produces the deciduous habit. The mesophytic forest includes the interesting conifer *Araucaria imbricata*, the Monkey Puzzle or Chile Pine of our gardens. This tree forms forests on rocky soils and attains a height of nearly 200 feet; it has a restricted distribution, one area lies on the Andes, from 37° to 40° S., another smaller group occurs on the coast Cordillera, about 38° S. Its habit when mature is not the conical tree of our parks, but an "umbrella" with a long clean stem surmounted by a broad spreading top, a type of tree-growth characteristic of Chile. The "park-land" grouping of trees amongst a low "pampa" or steppe vegetation has frequently been described as a feature of the scenery of South America, and it is also present in Chile where the forest thins out. Girdling the forests are scrubs of which the "Chusquea" or bamboo scrub may be mentioned as one which covers many square miles.

The xerophytic plant formations are found in the drier parts. Here the dense mesophytic forests are represented by extensive scrubs, in which only one tree is strongly represented. The "Espinales," consisting of *Acacia caven*ia, occupy extensive slopes along both sides of the long rift-valley of central Chile. The "Algarrobales" (*Prosopsis*) in the

oases of the north, the "Chanar" (*Gourliea*) in the dry north, and the Palm forest of *Jubæa spectabilis* in central Chile are given as other examples of these scrubs. Bush consisting of Cacti and of thorny shrubs is extensively present, whereas our familiar heaths and moors are only represented in some parts of the coast lands by *Empetrum rubrum* and several species of Ericaceæ. The principal xerophytic formations are steppes of grasses and other herbaceous plants which cover great areas and provide unlimited grazing grounds. These general summaries are amplified by numerous descriptions of definite areas, and occupy a considerable part of the book (pp. 161-270); the latter, although indispensable for detailed botanical studies, are less necessary from the geographical standpoint. Their study reveals a weakness of the book, its paucity of maps. Certain broad botanical features are represented on two maps, but for orographical and topographical maps one is compelled to refer to some of the larger atlases. This lack we have already pointed out in other memoirs of the *Vegetation der Erde* series, and in comparison with their size and get-up in other directions, it seems remarkable that no reference maps are provided.

The development of the Chilian flora is dealt with in the fourth part of the book. An exhaustive comparison of the species with those of other countries reveals a relationship to California on the one hand, and to Argentina and New Zealand on the other. The geologically oldest part of Chile is the coast Cordillera, consisting of crystalline rocks and some coal beds with plant remains. During the mesozoic period the greater part of North and South America emerged above sea-level, but at first the two countries were not joined. South America is believed to have consisted of a western nucleus, "Archiplata," and two other nuclei in the north-east, "Archiguyana" and "Archibrazil." The latter were separated by a long arm of the sea, the present Amazon valley, but both were continuous with Africa and India. Archiplata was at this time quite separate and was directly connected with New Zealand and Australia either by a great continent extending far into the Pacific or by extensions southward to an Antarctic continent. The Andes at this time did not exist, and there is evidence that their position was occupied by a narrow rift-valley. During the Cretaceous period there must have been a great submergence of the coast Cordillera, for the younger chalk beds are found resting directly on crystalline rocks. When the Tertiary period opened no great watershed existed in Archiplata, so that the flora of Chile and the Argentine side was continuous and existed under conditions more tropical than at present. Then followed the upheaval of the Andes, with accompanying changes in climate and plant distribution. The subtropical forests were divided, but there was left on the coasts of Chile the present forest, which is regarded as a remnant of the earlier one, fostered still by the moister climate near the sea. The gradual changes which followed the development of the Andes, the linking up of North and South America during the Pliocene period, and a subsequent glacial epoch, are the later phases, during which the present flora passed through its migrations and became sorted out. How the migrations took place can only be dimly guessed

at, but Dr. Reiche recognises in the present flora certain contingents of plants allied to those of other regions. These contingents are: (a) tropical American plants of the coast region, which represent the oldest stock of the mesozoic flora; (b) the Andine species, probably derived from tropical America; (c) the Californian-Mexican contingent, related to plants of Pacific North America; (d) the Antarctic plants closely allied to those of New Zealand and adjoining islands; (e) a northern contingent represented in South Chile by genera allied to those of Europe and North America; (f) marsh, aquatic, and strand plants, with a worldwide distribution; lastly, the "Flora advena," or latest arrivals of weeds and cultivated plants introduced by man from all parts of the world. The plants introduced from northern temperate regions have flourished exceedingly in the mild climate of Chile, and during the last twenty years the area devoted to the cultivation of wheat, barley, potatoes and fruit trees such as peach and vine has greatly increased. The native economic plants are not particularly numerous. Where the Araucaria occurs its seeds are a valuable source of food to the Indians, who secure the cones by the lasso and hold a special festival during the harvest time. The Jubæa Palm carries large crops of fleshy seeds with an oily kernel, and its buds are used to provide a sweet liquor which is fermented. The Myrtle family furnishes several kinds of edible berries, and others are collected from Cacti, a native bramble, and other plants. There is also a native Strawberry, and the cultivation of the Potato in this its native country now extends to 25,000 hectares. Chile has also enriched our own gardens and greenhouses by such plants as Calceolaria, Tropæolum, Fuchsia, Schizanthus, Lapageria, and others.

A METHOD OF DETERMINING LONGITUDE IN SCHOOLS.

By Frederick Mort, M.A., B.Sc., F.G.S.

The accurate determination of longitude is one of the most difficult practical problems that an astronomer has to deal with, and it is manifestly impossible to attempt this in schools *ab initio*. In any place, however, where a clock showing Greenwich time can be consulted, a method can be used similar to that used at sea where Greenwich time is obtained from chronometers. The chief value of experimental work is to elucidate and enforce principles, and this exercise illustrates the aspect of longitude which is of prime geographical importance, namely the relation between longitude and time.

The object of the exercise is to obtain correct "apparent" or "sun" time; then, if we know Greenwich time we can get the longitude from the fact that one degree of longitude corresponds to four minutes of time. Local time may be obtained by using either a sextant or a theodolite, and there are few secondary schools that do not now possess one of these instruments. In the following description we shall suppose a theodolite to be the instrument used, though a sextant and artificial

horizon would suit just as well. The watch is supposed to be set to Greenwich Mean Time (G.M.T.), which is readily obtained in most towns.

About a couple of hours or so before noon observe the sun through the theodolite and note the time. Keep the theodolite *at the same altitude* and be on the watch after noon to note the exact time when the sun comes down to its former altitude. Half way between these times the sun reached its greatest height, and this time therefore gives local noon expressed as G.M.T.

Greenwich Mean Time is now changed into Greenwich apparent time by applying the equation of time found from the *Nautical Almanac*, and the difference between Greenwich apparent time and the local apparent time is the difference in longitude between Greenwich and the observation station. The following is an example worked out for Allan Glen's School, Glasgow :—

Date, 14th May 1908.

	H.	M.	S.	
Morning time when sun reaches altitude 44° 8′ .	9	50	20	(G.M.T.)
Afternoon time when sun reaches altitude 44° 8′ .	2	36	0	(G.M.T.)
∴ Noon occurs at	12	13	10	(G.M.T.)
Equation of time		3	49	
∴ Noon expressed as Greenwich apparent time occurs at	12	16	59	

∴ Longitude of school is 16 min. 59 sec. W. of Greenwich.
i.e. Longitude of school is 4° 14·75′ W. of Greenwich.

The longitude from the Ordnance Survey map is 4° 14·8′.

For absolute accuracy a correction would have to be made for the change in the sun's declination during the experiment, but this is so minute that it may be disregarded. Clearly in this method errors of parallax and refraction are eliminated. One or two practical points may be briefly noted. When pupils are observing the sun through a telescope the teacher should obviously never forget to attend personally to the proper use of dark or coloured glasses. If two or three observations at intervals of ten minutes or so are taken before noon, the chance of the experiment being spoiled by a passing cloud is materially lessened. If horizontal readings are taken as well as vertical then the mean of two corresponding horizontal readings gives a due north and south line.

GEOGRAPHICAL NOTES.

EUROPE.

A Lake Survey.—An interesting study of a small lake, Le Lac de St. Blaise, appears in the *Bulletin de la Société Neuchâteloise de Géographie* (xviii.). The lake, which is near Neuchâtel, is of no great size, the greatest length being 474 metres and the greatest breadth 116 metres, but it reaches the considerable depth of 10·55 metres, or about 34 feet. The banks slope rapidly and the water is not very transparent, two facts

which have given rise to the local superstition that the lake is bottomless. The investigation, which has been conducted by some of the pupils of the Gymnase Cantonal of Neuchâtel, comprises a study of the history, hydrography and invertebrate fauna of the lake, and is an interesting proof that excellent work may be done at very small outlay, and with very simple appliances.

The Climate of Davos.—We have received from Dr. Hugo Bach a pamphlet on this subject, which forms Bd. xlii. 1 of the *Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft*. The paper is based upon the material furnished by the Meteorological Station at Davos, and, in addition to its tables, curves and summaries, contains a discussion on the hygienic aspects of the Davos climate. Of the general points which emerge from the investigation, the most important is the emphasis which the author lays upon the distinction to be drawn between the climate of an elevated valley and that of a mountain summit. As is well-known, a mountain climate tends to approach the insular type, but the Davos observations show that the elevated valley climate approaches nearer the continental type. As regards the different climatic elements, the pressure, as is to be expected from the elevation, is low, and the variations relatively small. As in other elevated regions, the maximum falls in the summer, not in the colder months as at lower levels. The valley is sheltered from the wind, and calms are frequent. The amount of cloud reaches its minimum in winter, and is small as compared alike with towns in the plain, *e.g.* Zürich, and with mountain summits, like the Rigi-kulm. The low pressure results in a low humidity of the air; in winter, especially, the difference between the amount of atmospheric moisture in the Davos valley and in the low ground is enormous. As a result again of this, and also of the broad shape of the valley, and of the reflecting snow mountains around, insolation is very strong. This insolation again gives the climate an extreme and thus a continental character. Not only does it produce a well-marked effect on the summer and winter means, but it also produces marked diurnal variations of temperature in objects exposed to the sun's rays. At the Schatzalp Sanatorium, which is placed about 300 metres above the floor of the valley, both the daily and the annual variations are less marked than at Davos; *i.e.* this station approaches nearer the mountain type of climate. On the other hand, it is to be noted that severe shade temperatures can be much more readily tolerated here than on lower ground owing to the stillness of the dry air, and its feeble conductivity. The mean annual precipitation is about 910 mm. (36 inches), that is not much more than half that of such places as Lucerne and Lugano (1710 mm. = 67 inches). The continental character of the precipitation is especially shown in the time of fall, for while the summer is wet the winter means, and especially the January mean, fall far below those of lower stations. Thus the mean January fall at Davos is under 2 inches (46 mm.).

As regards the physiological effects of the Davos climate, especially on persons in delicate health, the only point which we can mention here is that the evidence seems to show that the active agents do not appear

to be exclusively the meteorological elements as usually measured. It is possible that other factors, such as the electrical condition of the air, and its radioactive emanations, intervene to complicate the problem.

Africa.

The Geology of the East Africa Protectorate.—We have received a copy of Mr. H. Brantwood Muff's Report on this subject (*Colonial Reports*, 45). The report shows that the Protectorate consists of three broad zones of rocks, which are—(1) the Coastal Belt, formed of sedimentary rocks, which dip at gentle angles to the coast: (2) the Gneissic Region, which is formed of Archaean gneiss, and stretches from the inner margin of the Coastal Belt (mile 57) to the edge of the Kapiti and Athi Plains (mile 283), and thus includes the greater part of the eastern half of the Protectorate; (3) the Volcanic Region. The last-named is the most interesting area. It includes all the central and most of the western parts of the Protectorate, and south of lat. 1° N. includes an area of about 24,000 square miles. Within it lies all the land of altitude 5000 feet and upwards, and it thus contains all the region which is comparatively cool and fit for European colonisation. The region is traversed by the great trough of the Rift Valley, which is bounded on each side by precipitous scarps, and divides the region into the eastern or Kikuyu slopes, and the western or Nandi slopes. Both regions are built up of successive lava-flows and tuffs, and the perfect craters show that the eruptions producing these have been of late geological date. The dying phases of vulcanicity are indeed still represented by fumaroles, etc. While it is not necessary to summarise here Mr. Muff's account of the geological structure of these beds, his account of the superficial deposits is of great importance from the geographical point of view. These superficial beds fall into three categories:—(1) Red clay, (2) Black cotton soil, (3) Yellow loam. The red clay and the black cotton soil are essentially residual accumulations, while the loam has undergone a certain amount of transportation. The clay is confined to areas now covered with forest, or recently deforested, the distinction between the forests of the red clay and the grassy glades of the black soil being very marked. It is widely spread in the Kikuyu region, and also in the Mau district to the west of the Rift Valley. To the east the Kikuyu forest, which marks the distribution of the clay, ends in a well-watered strip of country with scattered trees, which still further east passes into the Athi Plains, characteristically treeless and covered with the black cotton soil. In the intermediate region the red clay occurs in thin patches. Where it is absent the volcanic rocks come close to the surface, but are nearly always covered by a deposit called by its Indian name of muram, which is pisolitic iron ore, and is smelted by the natives to get iron for their weapons. It seems clear that this belt is a deforested region, and that the hard "pan" of muram is the result of denudation of the red clay. The natives, especially the Wakikuyu, clear the forest in order to cultivate the soil. Once deprived of its natural protection, however, the surface soil rapidly wears away, and the rain acting on the fertile red

clay converts it into the useless iron pan. The natives then desert the clearing and make a new one. The deserted land grows poor grass, liable to drought owing to the thin soil, but trees will no longer grow upon these areas, except to a very limited extent, producing the "park-like" type of scenery. As much of the forest region will probably repay cultivation, it is evident that steps are necessary to prevent the erosion and destruction of the soil, especially rapid in this upland country of heavy tropical showers. The red clay shows a remarkable resemblance to the laterite of India.

The black cotton soil covers open rolling grass plains, such as the Athi and Kapiti plains, and is similar to the *regur* of India. It is treeless, and the soil is therefore subject to great surface evaporation. It lies over comparatively level areas, above impervious rocks, and therefore the drainage is bad; it is also slightly alkaline.

The yellow loam, which resembles the loess of China, occurs on the floor of the Rift Valley, and though it may form cliffs of 1000 feet in height, is so soft that it easily crumbles in the fingers.

The Report contains also a discussion of the water-supplies of the Protectorate. While over much of the area the water question is likely to present considerable difficulties with the development of the region, Kikuyu is fortunate in its abundance of perennial streams. But in connection with their flow Mr. Muff again emphasises the necessity for forest protection, the forest being the great stream regulator.

The Anghera Kabyles.—The *Boletin de la Real Sociedad Geográfica* of Madrid, vol. l., contains an article on the Anghera Kabyles, being a review of a book recently issued, *Desde El Muluyia! Sebú*, by D. Ricardo Ruiz. The territory inhabited by this tribe faces Gibraltar, being bounded on the north by the Straits, on the west by the Bay of Tangiers, and on the east by the country outside Ceuta. The people, both by their warlike qualities, and by virtue of their situation, have played a most important part in history from a remote period. It was from the spot where Jacub El Mansur afterwards built the city of Alcázar Sguer, that the invaders of Spain made their first start under Tarik. El Ksar served generally as an arsenal, the ships which harassed the Straits were constructed there, and the Anghera Kabyles furnished the most intrepid of crews. To-day they are the best armed of the tribes of Morocco.

An interesting note is given on the Isla del Perejil, or Taura as it is called by the natives, which stands about 6 miles from Ceuta, a rocky eminence rising 74 metres on the side facing the Strait. It has some strategic importance, and has from time to time been nibbled at by various Powers. In 1808 Spain, with the consent of Great Britain, took possession of it in order to watch the vessels of Napoleon. Later on it was evacuated by order of Ferdinand VII. from motives of economy, the troops retiring to Ceuta. In 1848 General Narvaez, after certain negotiations with Great Britain, again took the island in the name of his country, but does not appear to have occupied it definitely. Lastly, in 1887, when Spain wished to erect a small lighthouse there,

the authorities in Morocco contested the question vigorously, and so the rights to this island were lost to Spain. It has been asserted that the Isla del Perejil is identical with Ogygia, the island of Calypso.

Meteorological Investigation in Africa. — According to a message from Rome, Professor Palazzo, Director of the Central Italian Bureau of Meteorology, was to start early in July for Zanzibar in order to take part in an international scheme for the study of the monsoon winds on the coasts and in the interior of East Africa. At Zanzibar the professor will embark on the torpedo cruiser *Caprera*, from which he will make a series of meteorological studies, partly by means of balloon ascents, along the coast.

Simultaneously, British, French and German expeditions will proceed to the sub-tropical zone of the interior to engage in similar operations there. The most important of these expeditions is undoubtedly the German, which has been organised under the immediate patronage of the Emperor William, his Majesty contributing 50,000 marks (£2500) for the purpose of meteorological research on the Victoria Nyanza, and Professor Palazzo's mission on the coast will be especially connected with the work of this party.

The Anglo-Congolese Boundary.—The Anglo-Congolese Frontier Commission, which was despatched from London and Brussels eighteen months ago to report on the question of the disputed frontier between Great Britain and the Congo Free State, has now completed its work. The British Commissioner was Lieutenant-Colonel R. G. T. Bright, C.M.G., his assistants being Captain the Hon. F. Prittie, Rifle Brigade, and Captain E. Jack, R.E. The boundary to be surveyed was about 200 miles in length, and, commencing from the German border south-east of Lake Albert Edward, stretched to the southern limits of the Lado enclave. About 14,000 square miles have been mapped, including the whole of Ruwenzori. The Commissioners had not to fix the frontier—this remains to be done by negotiation between London and Brussels—but to report upon it, and their work in no way binds the respective Governments, who will deal with the matter through diplomatic channels.

The survey has shown that a mistake was made in the original maps which existed at the time when the Anglo-Congolese Convention of 1894 was concluded, and on which the Convention was based. The mistake made was that the 30th meridian, which was to form the frontier, was placed 20 miles further west than its true position. Thus, a strip of territory 20 miles wide and 120 miles long, which was thought to be British, is placed in Congo territory. The British contention is that the original Convention still holds good, and that the strip in question remains British. Meanwhile, it is being treated as a neutral zone. Should this strip be held to be Congo territory, it will deprive Great Britain of any access to Lake Albert Edward.

The two Commissions met at the south end of the boundary and worked slowly upwards to the southern boundary of Lado. A good deal of the country was practically unknown, and in places there was much

unrest among the natives, but the Commissioners had no trouble with the tribes, who, in the main, were friendly. Climatic and natural difficulties were great, the travelling over some of the country being very hard. The Commissioners visited a part of the Ituri forest, where they met many pygmies of the Mabutu tribe. Near the post of Mbeni, on the Semliki, there was a good deal of disturbance, the country being in a continual state of guerilla warfare. On Lake Albert Edward a visit was paid to a colony of natives who live on a floating village. It is said that these people originally took to the water for fear of lions. The natives live almost wholly on fish, and their houses are each erected on separate islands or rafts of papyrus. A terrible famine was raging in Busoga, and people were reported to be dying like flies, over three thousand having perished.

With regard to measures against sleeping sickness a very energetic policy is being pursued by the Uganda Government. The natives were being cleared away from the shores of Lake Victoria, which are practically depopulated, and all round Entebbe, the capital, the country had been cleared of vegetable growth.

Considerable activity is reported from the Kilo goldfields, about 20 miles across the border in Congo territory. These are being worked largely by Australians, and the first two lots of gold, amounting to £70,000, had just been taken out this year.

Sleeping Sickness in East Africa.—It is announced that a fresh Commission is being organised to proceed to East Africa to study sleeping sickness, to continue the work which was carried on from 1902 until it was temporarily suspended by the death of Lieut. Tulloch, who contracted the disease in Uganda. The new Commission will be in charge of Col. David Bruce, C.B., F.R.S., and will leave England on September 25 for Lake Victoria *via* Mombasa. The Uganda Protectorate is preparing a laboratory in the province of Chagwe, two miles from the lake, for the purpose of the investigation. The spot chosen will be within five or six miles of one of the concentration camps organised by the Government where sleeping sickness patients are under treatment. The work of the Commission will include the study of the natural history of the fly, and also of Dr. Koch's theory that crocodiles provide foodstuffs for *Glossina palpalis*. The Commission will also investigate the question whether the lower animals harbour the parasites, and the exact method by which the fly transfers the parasite.

America.

The Climate and Vegetation of Panama.—In *Science* for March 27 an abstract is given of a paper by Dr. R. E. B. M'Kenney on this subject. The differences between the Atlantic and Pacific sides of the Republic are very striking. On the Atlantic side there is no distinct dry season, though less rain falls in February and March than in the later months of the year. In the months of our winter the average temperature varies from 88° F. to 92° or 93°, and in our summer from

92° to 95°, the minimum temperatures being 60° and 65° respectively. In the Pacific province of Chiriqui, separated from the Atlantic side by the mountain backbone, the temperature range is about the same, but there is a very distinct dry season, which lasts for five or six months, and during which the vegetation becomes parched and dry. On the Atlantic side, notably at Bocas del Toro, the region studied, the vegetation is luxuriant, with almost impenetrable jungles, mangrove swamps along the sea-coast, and thickets of giant stemless palms. Further inland are forests of palms and exogenous trees, overgrown with aroids and other climbers. On the Pacific side, on the other hand, there are stretches of grass and sharply outlined patches of shrubs, agaves, and species of cactus. At Bocas del Toro bananas are now very extensively cultivated.

Polar.

The French Antarctic Expedition.—Dr. Jean Charcot is to leave shortly on his new Antarctic Expedition (*cf.* p. 101) in his ship the *Pourquoi Pas?* which has been specially built for ice work. A subsidy of £24,000 has been granted to the expedition by the French Government. The equipment includes two motor sledges.

Peary's New Expedition.—Commander Peary has started for a new expedition to the Pole. His ship, the *Roosevelt*, left New York for Oyster Bay and Sydney, Cape Breton, on July 6.

Save for such modifications as have been suggested by the experience and discoveries of the last expedition, Commander Peary will follow the same programme and route. After leaving Sydney the *Roosevelt* will make for the Strait of Belle Isle, the Davis Strait, Baffin Bay, and Smith Sound. When the Whale Sound region is reached, the crew will be supplemented by Eskimos and dogs, as before, for sledge work. For winter quarters Commander Peary will endeavour to force the *Roosevelt* to the same point on the north shore of Grant Land as he occupied in the winter of 1905-6. Commander Peary will utilise Smith Sound or the "American route," which he declares must be accepted as the best of all possible routes for an aggressive attack on the Pole. He says it is a land base a hundred miles nearer the Pole than is to be found at any other point of the entire periphery of the Arctic Ocean.

Expedition to the Mackenzie River.—An expedition, under the combined auspices of the American Museum of Natural History and the Geological Survey of Canada, has started for the Mackenzie River and the adjacent country, to collect ethnological and zoological material. The party is being conducted by Mr. Stefansson, who is already well acquainted with the Eskimos of the region, with whom it will be remembered he wintered during 1906, and Mr. R. M. Anderson, a well-known naturalist. The expedition has been organised for the purpose of making scientific studies of the Eskimos of the country, of procuring collections illustrating not only the material cultures of the uncivilised tribes of the region, but also of the zoological conditions which

prevail there, and of increasing our knowledge of the region. The expedition will begin its return journey during the summer of 1909.

General.

International Fishery Congress.—We have received an intimation that a Fourth International Fishery Congress will be held at Washington from September 22-26, on the invitation of the United States Bureau of Fisheries. Some interesting excursions will be made in connection with the Congress. Those who may desire to become members are requested to communicate with the Secretary-General, Deputy-Commissioner, United States Bureau of Fisheries, Washington, D.C., as early as possible.

Glacial Erosion.—We have already analysed here an article by Professor Brunhes on glacial erosion and his explanation of the phenomenon of over-deepening, an article which appeared in the annual volume of the *Revue de Géographie.* While we cannot at present give further space to this interesting question, we may just draw attention to a further article by the same author which appears in the *Revue Générale des Sciences* for February 15. This article also is illustrated by some admirable photos, and as these represent for the most part familiar Alpine scenes, which the author discusses from a new point of view, those who propose to visit or revisit the Alps during the present summer may be glad to have their attention specially called to the article. In the text Professor Brunhes further elaborates the thesis set forth in the article already discussed, and the whole suggests that we are at least approaching the time when some general consensus of opinion will be reached on this hitherto so keenly debated question as to the extent to which ice can erode.

Lake Ramparts.—We have received from Mr. G. K. Gilbert a reprint bearing this title, the paper having been originally read before the Sierra Club, and published in their *Bulletin* (Jan. 1908). The phenomenon discussed, though it does not appear to occur in our mild climate, is one of considerable interest in connection with ice problems, and is treated by Mr. Gilbert so as to illustrate in a very striking way the meaning of scientific method.

On the shores of many lakes in the Sierra regions, as also on the shores of Canadian lakes, and of those in some other parts of North America and in parts of Northern Europe, rows of boulders occur. These sometimes form a low rampart, at other times a mere line; the boulders are of various sizes, up to a diameter of several feet, and they always occur close to the water's edge. The boulders in every way resemble the glacial erratics scattered over the adjacent land surface, except in their regularity of arrangement. Where they occur it is further noticeable that boulders are absent from the shallow water region of the lake. Mr. Gilbert discusses the various hypotheses that have been put forward to account for these "ramparts," and shows finally

that the only one which explains all the facts is the view that the regular arrangement is due to the contraction and expansion of the lake ice in winter. The ramparts only occur in regions where glacial erratics occur freely, and it is therefore to be presumed that such erratics formerly occurred in the shallow water of the lake no less than on the neighbouring land. It is the movement of the winter ice which has pushed these boulders out of the shallow water to the beach, where they form the characteristic ridges. The phenomenon only occurs where the winter sheet of ice reaches a considerable depth, and where the winter temperatures are extreme. As is well known, ice once formed acts like any other solid in that it expands with a rise of temperature, and contracts with a fall. By a series of interesting diagrams Mr. Gilbert shows that while the under surface of a thick layer of ice is kept more or less constantly at a temperature of 32° F., owing to its contact with the water beneath, the upper layer contracts and expands with temperature variations in the air. The result is the formation of extensive cracks, and also the buckling up of the ice sheet, which is pushed up over the shore at its margins. As it rises along a gently shelving shore it carries with it whatever solid bodies occur in the shallow water—hence the rampart formation.

Commercial Geography.

Railway Development in South Africa.—The negotiations between the British South Africa Company and the Congo Free State, which have been in progress for some months with a view to the extension of the Northern Rhodesia railways to the Tanganyika mining area, are now practically completed, Reuter's Agency learns, and it only remains for the signatures of the contracting parties to be affixed to the agreement reached. The effect of this arrangement will be the rapid development of the Katanga mines by a through railway route to the eastern and southern ports, and it will also ensure the supply from the Rhodesian coal area for the working of the Katanga mines and the further opening up of Northern Rhodesia.

The agreement also ensures the construction of another section of the Cape to Cairo railway from its present terminus at Broken Hill to the Congo Free State, and for this purpose negotiations are in active progress. The whole of the next section northward of the Cape to Cairo railway to the Congo having already been surveyed, it is expected that work will commence during the present dry season and will be easily completed in a year, when there will be direct railway communication between Cape Town and the Congo.

Products of Southern Nigeria and Gambia.—A recently opened section of the Franco-British Exhibition at London is that devoted to Southern Nigeria and Gambia, which includes samples both of the economic products and of the native arts and handicrafts.

Of Southern Nigeria, the staple product has long been palm oil and palm kernels, the exports of which last year were worth nearly £3,000,000,

and of these there are of course numerous samples on view. Rubber, the next most important product, which was exported to the value of over £150,000, is also well represented, and among other forest products there is a fine series of slabs of polished mahogany, together with several tables made of indigenous woods by native workmen. Another large section is devoted to cotton and cotton-seed, the exports of which are increasing in a most satisfactory manner, the value having risen from £200 in 1902 to over £100,000 in 1907; and there are a number of cloths of native manufacture, some of which are of considerable artistic merit. Agricultural products are represented by Guinea corn, maize, rice, coffee, cocoa, ginger, and other articles, and among the minerals, which include lignite, are some samples of bitumen, the existence of which raises hopes that oil also will be found.

The Gambia colony's exhibit stands side by side with that of Southern Nigeria, the two, in fact, forming one stand. Samples are shown of the ground nut, or monkey nut, which accounts for more than four-fifths of its total exports, as well as of its numerous other vegetable products, such as rice, maize, millet, cassava, rubber, indigo, and various timber woods; and there is a large series of roots, herbs, etc., forming part of the native pharmacopœia, which seems remarkably extensive and contains remedies for almost every ailment.

Cotton in Central Asia.—An article in the *Bulletin of the Imperial Institute* (vi. 1) gives an account of the present condition of cotton-growing in Central Asia. Native varieties have been grown from time immemorial, but the fibre is of inferior quality. After various unsuccessful experiments it was found that American Upland cotton is suitable to the local conditions, and this variety is now increasingly grown. The climate is, of course, continental, but the summer's heat is enough to ripen both cotton and rice; the two great difficulties are (1) the early onset of frost, and (2) the lack of water in the growing and flowering season, which makes irrigation necessary. The soil of Turkestan—a loess-like loam—is not infertile, and though salt occurs in the sub-soil, and effloresces to the surface after rain, this is not injurious to cotton. The methods of cultivation are highly primitive, and too little attention is given to manuring. As a general rule, the silt of the irrigation water is alone relied on as a fertiliser, and as rotations are not properly practised, the yearly yield of the land is decreasing. In view of the difficulty of obtaining animal manure, it will probably be necessary to have recourse, in the future, to artificial fertilisers. As well as the cotton fibre, the seed is used both as a source of oil and very extensively as fuel; barracks, garrison kitchens, and private houses are almost exclusively heated by cotton seed. Cotton seed for heating purposes fetches about 1½d. to 3½d. per 100 lbs. The difficulties of transport of the fibre are great. It reaches European Russia by two routes:—(1) By rail from Tashkent through the town of Turkestan to Orenburg and Samara, where it joins the railways of European Russia; (2) over the Trans-Caspian military railway through Samarkand, Merv and Askabad to Krasnovodsk on the Caspian Sea, whence the bales go by steamer either up the

Volga or to Baku, and then by rail to Batum or Poti on the Black Sea. The great difficulty is the transport of the cotton from the interior to the stations, which must be effected either by ox-carts or by camels, whose rate of progress on *good* roads is about $2\frac{1}{2}$ to 3 miles per hour. In the rainy season the soil is converted into a sticky mass, and the roads become impassable to wheeled traffic. The profits of cotton-growing are not very great, but it seems probable that with improvement of methods the Central Asiatic Territory will be quite able to supply the Russian market for cotton.

EDUCATIONAL.

We noted here in our June issue (p. 268) the fact that Professor Davis of Harvard University proposed to engage in field research in the Alps during the present summer. We learn from *Science* (xxvii., p. 758) that this is part of a larger scheme devised by the instructors in the department of geology and geography at Harvard, with the object of combining research work with summer teaching. Several members of the department have arranged to undertake pieces of research in which they can be accompanied and assisted by advanced students desirous of studying methods of field work. Thus Dr. G. R. Mansfield is to undertake field work in historical and structural geology in Montana. Professor J. E. Wolff geological or petrological work in Montana or New England, Professor D. W. Johnson physiographical research in Central France, and Professor J. B. Woodsworth geological field work in Brazil.

In *Science* (No. 698, p. 792) there appears an interesting account of a coral island model, recently set up in the coral room of the Museum of Comparative Zoology at Harvard University. The model represents Bora Bora, one of the Society Islands, and is based upon surveys specially made for the purpose. It is on a scale of about $1\frac{1}{2}$ feet to a mile, the vertical and horizontal scales being the same, and is painted in natural colours. The central island, peopled by about two thousand Polynesians, is about five by three miles in diameter. It consists of the dissected upper part of a great volcanic cone rising from the floor of the deep sea in the form of a steep-walled central knob, about 2500 feet in height, surmounting a group of radiating spurs. The lower slopes are heavily wooded, and are washed by the waters of the lagoon, which reaches a depth of some fifty fathoms. This lagoon communicates with the sea by a passage through the outlying shoals and the narrow barrier reef which forms the external border of the concentric island system. A little further out the sea bottom deepens rapidly at an angle of nearly 45°, and thus soon descends to a depth of 2000 fathoms or more. The deep ocean floor would on the scale of the model be reached near the floor of the room in which the model stands, but the ocean depths immediately surrounding the reef are suggested by the deep colouring of the water, and by placing models of vessels near this margin. It is

stated that the use of natural colours and true proportions gives the whole model a most realistic appearance. The line of breakers on the outer barrier reef, the sails of the boats in the lagoon, whose hulls are hidden by the palm-trees at its margin, the villages at the foot of the inner mountainous island, the lower wooded slopes, the central dominating peak—all, it is stated, are seen in the most realistic fashion by placing the eye at sea-level; and it is obvious that the whole must form a most instructive picture of one form of land-building, and of human activities as determined by surface relief. The model, which is the gift of Mr. Alexander Agassiz, must obviously have been of a very costly nature, but must also be of great educational value. It is unfortunate that such models are so rarely seen in this country, for even those of a much less elaborate nature are of enormous use, almost indispensable indeed in the teaching of map interpretation.

Some of our teacher associates may be glad to have their attention drawn to an address with the title, *Mankind and the Oceans*, published by Professor Fr. Schrader in the *Revue de l'Ecole d'Anthropologie* for February. The lecture was apparently delivered as an introduction to a course of Anthropological Geography, and though it does not lend itself easily to the purposes of an abstract, contains some charming thoughts, gracefully expressed. The author, like Suess, emphasises the difference between the Atlantic, with its gently-sloping shores and many great tributaries, and the Pacific, bounded by a steep coastline and with practically no great estuaries, and correlates with this the difference between the maritime civilisation which has arisen on the borders of the Atlantic, and the wholly different type to be found about the Pacific. Again, he re-states in a somewhat novel form the old facts about the circulation of the atmosphere, always emphasising the influence of the ocean—it is the influence of the ocean which has made the Mediterranean climate, and with it Mediterranean civilisation; the downpour of the monsoon rains, determined again by the interrelation of sea and land, has resulted in the dense population of eastern and southern Asia; the warm currents of the Atlantic have played their part in civilising western Europe and so on. Again, he correlates the art and so the whole life of Greece with the tideless Mediterranean, which permitted a freedom of communication impossible in regions where navigation is controlled by its despotic ebb and flow. These are only a few random thoughts picked from an essay in which many of our readers will find a real charm, a proof that among its other good deeds geography may afford a means of linking together literature and science, though many scientific works suggest that the gap between the two is not inconsiderable.

NEW BOOKS.

EUROPE.

"Les Pays de France. Collection des Écrivains Régionaux."
Promenades en Savoie: par Henry Bordeaux.
Le Deuil du Clocher: par Joseph Ageorges.
Passions Celtes: par Charles Le Goffic.
Nouvelle Librairie Nationale. Paris, 1908.

This series, of which we have received the three volumes named above, if not directly geographical in design, is at least of importance to the geographer in that its object is to interpret the inner life of the different provinces of France, by means in every case of the pen of a native. The three volumes consist of sketches and tales, scraps of folklore, descriptions of journeys, and so forth, all with a definitely regional flavour. Of the three volumes that dealing with Savoy is most directly interesting to the geographer, who will find much that is delightful in, for example, its treatment of the literary associations of Lac Bourget and Chambery, and in the account of the deserted Chartreuse du Reposoir, in whose cells and corridors there now reigns the same silence that is so impressive at the Grande Chartreuse, and which is evidently well worth the trifling détour from the beaten track necessary to see it. In some other parts of the same volume, as also in the other volumes, the imaginative element is more in evidence than the descriptive, but nevertheless we can cordially recommend the series to the travelling geographer. The volumes form an admirable supplement to the ordinary guide-book, and the style is in all cases sufficiently light and simple to permit the books to be read *en voyage* with pleasure and profit.

Slavonic Europe: A Political History of Poland and Russia from 1447 *to* 1796. By R. Nisbet Bain. Cambridge Historical Series. Cambridge University Press, 1908. *Price* 3*s.* 6*d. net.*

This book is one of the Cambridge series of histories of modern Europe. It is a model of comprehensive compression, containing as it does only nineteen chapters, yet the aim of the series seems to have been fully carried out. These books are intended for the use of all persons anxious to understand the nature of existing political conditions, as well as for students of history and geography. The author in his preface says his book is the only existing compendium, in English, of the political history of Poland and Russia from the middle of the fifteenth to the end of the eighteenth century. We are all more or less familiar with the romantic and poetic side of the story of Poland's struggles for independence, and her final partition, but this history dispels any illusions as to the true character of many of the actors on that ever-shifting stage: and however much our sympathies may be with the Poles, we cannot but anticipate their ultimate extinction as a nation on reading through these pages.

Mr. Bain naturally, when dealing with Slavonic Europe, has a good deal to say about Muscovy—as Russia was then called; and the student of geography will find much to interest him in the story of the evolution of what is now known as the Russian Empire.

Mr. Bain is to be congratulated upon this volume, which, in addition to being written in a style adapted to the general reader, is sufficiently erudite to satisfy the scholar. There is also a comprehensive bibliography at the end of the volume, and two maps illustrate the text.

La France au Soleil: Notes sur l'Algérie. Par Henry de Bruchard. Paris: E. Sansot et Cie., 1908. *Price* 3 *francs.*

We find it very difficult to classify this book, or even to guess at what could be the object of the author in writing it. It is not a description of Sunny France, *i.e.* Algeria; it is not a history nor a romance; the best description we can think of is that it is a rhapsody in which the writer descants at large on the glories of the French army in the conquest of Algeria, and predicts a great future for the colony when it has been thoroughly Frenchified. Interspersed with this are some slight sketches of scenes mostly in the towns of Algeria, and a chapter is devoted to the literature of Algeria, *i.e.* French writers who have written on Algerian subjects. It is not the class of work which is much appreciated on this side of the Channel, but it will doubtless find much acceptance on the other.

La Suisse au XX^e^ Siècle. Par Pierre Clerget. Paris: Armand Colin, 1908. *Price* 3 *fr.* 50.

Switzerland is often called the "Playground of Europe," but, as this valuable work shows, it is one of the busiest hives of industry in the world. It furnishes the author with the means of presenting us with an economic and social study of the most interesting and instructive kind. For example, we find that the Swiss believe in *two* legislative chambers, and that the consent of both chambers is necessary to make a law; but, in addition to this safeguard, if 30,000 citizens demand in writing that a law be submitted to popular vote, a Referendum takes place, and the whole electors vote upon the question whether the law shall be passed.

By law passed in 1886, the Swiss Confederation has a monopoly of the manufacture and importation of spirituous liquors, the profits going to the Cantons proportionally to their populations. The author does not consider that, as presently administered, this monopoly is a measure of good social hygiene.

Two-fifths of the population of Switzerland are occupied with the different branches of agriculture, and small holdings are everywhere predominant, their respective extents depending upon the district. Unfortunately complete statistics are wanting. In 1900 forests covered 20·5 per cent. of Switzerland, or 847,284 hectares. Most of these forests (66·9 per cent.) belong to the communes and corporations, 44 per cent. to the Government (chiefly owing to the secularisation of the property of convents), and only 28·7 per cent. to private persons. The Swiss forests are estimated to yield annually a return of 40 millions of francs.

In 1900, while 2,312,949 Swiss habitually spoke German, only 730,917 spoke French, and 221,182 spoke Italian. In the same year the Protestants represented 578 per thousand, and the Roman Catholics 416 per thousand of the total population. Divorces are much more common in Protestant than in Roman Catholic districts, and more frequent in towns than in rural districts.

Switzerland contains neither coal nor metallic minerals. Its chief industries are the manufacture of embroideries, watches, machines, cottons, and silks, with a great trade in milk. 133,000 persons are engaged in home industries, chiefly textiles and watches. Bâle, Zurich, and St. Gall are the great centres for the silk and cotton manufactures.

As two to three million tourists annually visit Switzerland, it is not surprising that there were, in 1905, 1924 hotels, and that the hotel business had an annual turnover of 200 million francs, and occupied 33,480 persons of both sexes, receiving in wages more than 8½ millions of francs. The capital employed in connection with hotels reached 777½ million francs, and an annual profit was received of some

36 millions. In 1906 the percentage of tourists' nationalities was as follows: German, 31 : Swiss, 22·2 ; British, 13·5 : French, 12·1 ; American, 5·8 ; Italian, 4·6. July and August are the chief tourist seasons.

Mountain railways form a Swiss speciality. The highest is to the Gorner Grat (3136 mètres), but that proposed up the Jungfrau (4000 mètres) has been objected to by 68,000 Swiss, on the ground of vulgarising fine scenery, and has been remitted to the Federal Council. A tunnel piercing the Lötschberg will connect Berne and the Rhine Valley with the Simplon route.

Not many years ago the Swiss were ardent Free Traders, now they have adopted strict Protection. The volume is so full of information either by the author himself, or resting on official statistics or the cited works of recognised authorities, that one regrets that there is not a detailed index, and also a better map of Switzerland than that supplied at page 23. We may add that the author was connected for eight years with Swiss educational institutions, but he does not describe either the educational or the military organisation of Switzerland.

Historical Geography on a Regional Basis. Vol. I., The British Isles. By Ernest W. Dann, B.A. (Oxon.). London : J. M. Dent and Co., 1908. *Price 2s. 6d.*

This is the first volume of a work, of which the other is to treat of Europe, the rest of the world not being discussed because of limitations of book size. The author writes : "The main purpose of this book is to show how physical conditions have affected history. A subsidiary object is to warn the student against allowing himself to be drawn into too broad generalisations. . . . Differences in religion have made history ; royal marriages have made history ; organisation or its lack has made history ; individuals have made history. Do not let us lose sight of any of these when we are studying the effect of geography." It happens, unfortunately, that "history" as here treated is too much the "drum and trumpet" history that deals with invasions, campaigns, and battles ; there is perhaps not enough of the influence of geographical conditions on the development of the more peaceful aspects of human life.

The book contains twelve chapters. The two first are introductory. The third contains a crisp and well-written outline of the regional geography of the British Isles, giving those "details of the physical configuration" that control lines of communication, and are therefore "absolutely necessary to the understanding of the chapters which are to follow." After a discussion of the route of immigration of constituent peoples, there follow chapters on London, Wales, Scotland, and Ireland, and on the development of modern county divisions. Chapters on sea-power, on historic towns, and on Greater Britain complete the volume.

The author says, "We wish to be suggestive, and make no attempt to be exhaustive." The book is certainly suggestive, and cannot fail to stimulate thought and interest, but it must be noted that it presumes a very considerable acquaintance with the history of the British Isles and the British Empire. Stress is rightly laid on the importance of the use of good maps, but the black and white ones in the book, with elevation shown only by varying hatching, are certainly not nearly so clear or attractive as maps in tint would be. We note an objectionable feature in the use of "up" and "down" in place of the proper terms of geographical direction, and the frequent blundering "England" and "English" that so often disfigure books written in the south part of Great Britain. There are some flippancies of phrasing that might well be amended, and a few minor inaccuracies, such as the bringing of the largest ocean steamers up to Glasgow

(p. 4), the battle of Carberry Hill (p. 100), and the applying of the term "Rockies" to the whole of the western highlands of Canada (p. 17). These, however, are but small defects in a book that shows thought throughout; they can easily be remedied, and they scarcely detract from the essential goodness and usefulness of the work.

The Enchanting North. By J. S. Fletcher. London: Eveleigh Nash, 1908.

Though the fact would hardly be guessed from the title, this book deals with the northern counties of England, and is apparently intended to be a tourist guide. Though it is not expressly so stated, we gather from the accompanying map, and from the illustrations, that it has been got up under the auspices of one of the great railway companies. The volume may be of use to those to whom the attractions of the parts of the country concerned are totally unknown, but it is hardly accurate enough to have value for the geographer. The ornithologist will, however, perhaps be interested to learn that the "eider-*down*" is a bird found on the Farne Islands.

ASIA.

From Pekin to Mandalay: A Journey from North China to Burma through Tibetan Ssuch'uan and Yunnan. By R. F. Johnston, M.A., F.R.G.S. With map and illustrations. London: John Murray, 1908. *Price* 15*s. net.*

The author of this book is a not inexperienced traveller in the Far East. For the journey here described is not the first accomplished by him in those regions—in order, if one is to take him at his word, to escape into the solitudes of wild Nature out of the din and strife of our "boisterous civilisation." He has held for several years the post of District Officer in the leased territory of Weihaiwei, and possesses knowledge of the languages of China and an acquaintance, derived from personal intercourse, with Chinese customs and character. Further, he has a friendly and sympathetic interest in the eastern races generally classed as constituting "the Yellow Peril." And, lastly, he is a student of questions—some of them still in initial stages of observation and inquiry—of race and language, sociology and religion, which present themselves in South-Western China, South-Eastern Tibet, and Upper Burma—the region of lofty mountain ranges, elevated plateaus, and great river systems, which lies between the Yalung affluent of the Yangtse on the east and the upper waters of the Salween and Irrawady on the west. Great tracts of this region as yet remain practically unexplored by the white man. Except along certain lines of possible railway extension northward from Upper Burma into Western Yunnan and Ssuch'uan, their orographical features and river systems are known only in a general way, while little has yet been done towards ascertaining their natural resources and forecasting their possible developments.

The expedition into those regions was a somewhat adventurous one. The author's outfit and retinue were of the scantiest; and he trusted for supplies and shelter, as well as for carriage and conveyance, to what, from day to day, the way might provide. Yet as far as serious difficulty or opposition, or even discourtesy and aloofness on the part of the inhabitants and their rulers, were concerned, the journey was as uneventful in those wild and little visited regions as in the better-known parts of Central China which were traversed before they were reached. This may be taken as at once an indication of the natural disposition and temperament of the inhabitants—possibly of the influence also of Buddhism—and evidence of the tact of the traveller and the suitability of his methods.

The author says (page 168) that the details of his daily march through the mountains of Chinese Tibet to the borders of Yunnan will hardly be of interest to any but those who are themselves travellers, or are contemplating a journey of a similar kind. There are not likely to be many such among his readers. And the remark is scarcely fair to himself or to the geographically minded, a body of persons by no means, in these days, limited in number. If his narrative discloses no incidents of striking adventure or discovery, it will nevertheless be followed with interest as describing the course of a journey successfully carried out, with little pomp and circumstance, without serious loss of transport animals or (with one exception) of material, through new and all but unexplored territory on the confines of countries whose development and future history have become matter for curiosity and attention to the western world. It has, moreover, as already suggested, given the author opportunity to set forth much information gathered by him regarding the political condition, the religions, and the races and languages of that territory. These were subjects more interesting to himself, perhaps, than (apart from the scenic aspects of Nature) were the topography and physiography. Indeed, it may not unreasonably be supposed that one among other motives in the publication of the book was the desire to give expression to his views on such questions as the character and capabilities of the Far Eastern peoples generally, the present and probable future relation and attitude of these peoples to the Westerns who hitherto have regarded and taken advantage of them as inferiors, their religious future, and the Christian missionary enterprise among them. Observations and disquisitions well worth considering upon these, as well as upon the racial and linguistic affinities of the Tibetan and Yunnanese tribes, will be found throughout the book, but more especially in the final two chapters, in Chapters VI. and VII., in which Mount Omei and Chinese Buddhism are described and discussed, and in the collection of Notes at the end of the volume.

As a whole the book is commended to the attention of our readers.

The Mongols: A History. By JEREMIAH CURTIN. London: Sampson Low, Marston and Co., Ltd., 1908. *Price* 12*s.* 6*d. net.*

In a "foreword," or, as we on this side of the Atlantic call it, an introductory note to this remarkable volume, the President of the United States tells us some noteworthy facts about the personality of its author. He was a native of Wisconsin and in the diplomatic service of the American Government; a man of exceptional and varied abilities, he found time to make many valuable contributions to literature, such as translations of historical Polish novels and investigations into the folklore of several races. But his most important work is the volume now before us, a history of the Mongols, a branch of history in which, according to the President, "no other American or English scholar has ever approached him." And certainly a perusal of this work produces on the mind of the reader the impression that the encomium of the President is well deserved. Into some 400 pages Mr. Curtin has compressed the story of the rise and fall of the Mongol Empire, which at first consisted of a few tracts somewhere south of Lake Baikal inhabited by nomad robbers, and at its zenith included China, Persia, parts of India, Russia, Hungary, Poland, etc., and received its first check, not from any European power, but from the Turkish Mamelukes in Egypt. The story begins with the commencement of the thirteenth century and ends with the beginning of the fifteenth, and it is hardly too much to say that from first to last it is a nauseating record of horrors. The chief character is, of course, the famous Jenghiz Khan, whom Mr. Curtin pronounces to be "perhaps the greatest character

in history that has appeared in the world up to the present day." Treacherous, unscrupulous, brutal, cruel and profligate, he "stands forth as the greatest man-slayer the world has ever known. From 1211 to 1223 in China and Tangut alone Jenghiz and his assistants killed more than eighteen million five hundred thousand human beings." Among his successors the only one who has even a faint claim on our admiration is his grandson Kubilai, better known to us as the Kubla Khan of Coleridge's dream-poem. Readers of Marco Polo will not fail to remember the graphic descriptions of the magnificence of his court. After his death at the end of the thirteenth century the Mongol Empire decayed rapidly, owing to the continual family dissensions and the profligate and treacherous character of the claimants to the throne. This magazine is not the place for a detailed account of the rise and fall of the Mongol Empire, but to all students interested in a somewhat little known but very important period of Eastern history we strongly recommend the careful perusal of this book. Recent events in the East furnish an additional reason for an earnest survey of what is known of its history in the past, for, as Mr. Curtin observes, "remarkable as has been the part played by the Mongols in history, the part to be played by them yet may be far greater. How great and how varied it may be, and of what character, is the secret of the future."

To-day in Palestine. By H. W. Dunning, Ph.D. London: T. Werner Laurie, 1908.

This book, we are informed, is "written primarily for the traveller," and from internal evidence it is clear that it is intended for the American traveller. Baedeker gives much more information, and is not unduly padded; but then Baedeker is not written in the colloquial jocular style, which still has a number of admirers on the other side of the Atlantic. "Poor Ahab had no automobile." "Abraham was rich and powerful . . . only the comfort of a pipe was denied him." "The place between Sidon and Beyrouth where the whale landed his passenger,"—*i.e.* Jonah; "many of the citizens of Tiberias are so filthy that no self-respecting cholera germ would come near them." Expressions like these may still be counted humorous or amusing in America, but they are no longer acceptable in Europe. The writer has made ten journeys in the Holy Land, and tells us "it is important in the study of Palestine not to seek to prove or to disprove the Scriptures, but to try and discover the actual facts." Nevertheless we may search this work in vain for any attempt to investigate, far less to discover, a fact; but in place of this we have strange versions of various Biblical stories revised and set forth according to the ideas of the author. We doubt if this work will meet with much success on this side of the Atlantic, where there are a score of guide-books and authorities on the Holy Land, all of them much superior to this one in useful information and literary merit.

In a Syrian Saddle. By A. Goodrich-Freer. London: Methuen and Co., 1908. *Price 7s. 6d. net.*

This volume is a reprint of one published three years ago giving a very pleasantly written account of a tour in the land of Moab, Galilee, and Samaria in 1903. The narrative consists of a series of sketches describing the scenery and localities through which the party travelled. The "Lady" of the party, who is the authoress of the book, evidently enjoyed herself thoroughly, and she had every reason to do so, for her companions were a doctor, two sportsmen, and a learned professor, "the greatest epigraphist in Europe, the representative of a Royal Personage, and armed with all the permits and safe-conducts and special privileges

useful in a land of cholera, quarantine, and backsheesh." They rarely went off the beaten track, but they preferred the less frequented roads so as to visit comparatively unknown places. The authoress has no exciting adventures to relate—nothing worse, at any rate, than the difficulties incidental to atrocious roads or paths or to a spirited or capricious horse. She is enthusiastic about the beauty and the weirdness of the scenery through which from time to time they passed, and which she describes with great skill and even eloquence. Her readers profit as much as she did by the encyclopædic knowledge of the professor, and altogether she has succeeded in compiling a very interesting and enjoyable work.

AMERICA.

The Andes and the Amazon. By C. Reginald Enoch, F.R.G.S. London: T. Fisher Unwin, 1908. *Price* 21*s.*

It is not surprising that this interesting and instructive book has reached a second edition within a year of its publication. The author, an engineer, sometimes in the employment of the Peruvian Government and sometimes on his own business, has travelled again and again over many of the little-known tracts of Peru, has repeatedly crossed the Andes, and has penetrated far into the dense forest regions on the other side of these magnificent mountains. He has a graphic and facile pen, and the command of a clear, nervous, and vigorous style; he has not only the artist's eye to perceive the beauties of a landscape, but he can reproduce them in a charming word-picture for the benefit of his readers. His observations on the geology, anthropology, and antiquities of the tracts he visited are well worth careful consideration, as also his remarks on the present condition of the inhabitants of Peru, from the most degraded of the aboriginal Indians to the governing class. Mr. Enoch is obviously intent on being impartial, but he has the courage of convictions, based on wide and exceptional experience, and he does not hesitate to criticise freely everything from the doings of the priests to the state of the roads, but he is careful to avoid all discourtesy and whatever might cause bad feeling or annoyance. In the course of his journeyings he ran many risks and encountered many dangers, such as are incidental to mountain-climbing and to exploring in trackless forests, not to mention earthquakes and revolutions, and his account of them shows him to be a man of much fertility of resource, presence of mind, and calm resolution in the face of multiform difficulties. His book will be welcome to the geologist, ethnologist, antiquarian, and student of history, as well as to the politician and intending emigrant. He is frankly an admirer of the Peruvians, and an enthusiastic believer in the great possibilities of the future of Peru. He shows that within its huge area, thirteen times the size of England and Wales, the agricultural and mineral resources are practically unlimited, and that now, when what we may call the season of revolutions and war has ceased, the development of this rich and fertile country is merely a matter of time. It is still delayed and hampered by internal misgovernment and the neglect and distrust of European capitalists and nations, but if peace continues and education spreads, the system of government is bound to improve, and its external and internal commerce must increase to an extent which can hardly be estimated now. With an increase of population, now only four to the square mile, there will come improvements in communications by sea and by land of which Peru is now sorely in need, and which are essential to its future prosperity. A word of praise is due to the many illustrations, photographs, and sketches, and to the very useful map with which the work is equipped.

AUSTRALASIA.

Bush Life in Australia and New Zealand. By Dugald Ferguson. Fourth Edition. London and Edinburgh: Sands and Co., 1908.

The fact that this story has reached a fourth edition is sufficient evidence of the public estimation. Its strength does not lie in its style, which is somewhat stilted, but in its vivid and truthful descriptions of incidents of up-country life in Australia and New Zealand; and wild horses, blacks, and bushrangers afford plenty of healthy excitement. The period is that of the gold rushes in the fifties.

Australia. Romance of Empire Series. By W. H. Lang. London: T. C. and E. C. Jack, 1908. *Price 6s. net.*

It is a bold thing to advertise a narrative of fact as romance. Yet the story of Australia has so much in it which appeals to the imagination that the reader of Mr. Lang's book is forced to admit that there is no misuse of language. Australia does not boast of an ancient lineage. If one excepts the old Dutch and Spanish voyagers whose discoveries had no practical result, its exploration covers little more than a century. Many famous names, such as Hamilton, Hume, Stuart, Eyre, and Mitchell, are associated with the work, and Australia to-day is reaping the reward of the indomitable spirit which sent them forth.

Australia has two subjects which specially lend themselves to description in a book such as this, viz. gold-digging and bushranging. The one has been superseded by modern mining, and the other has disappeared under the strong arm of the law. Yet it is scarcely thirty years since the dispersal of the famous Kelly gang, and men are living yet who witnessed the capture. Of both subjects Mr. Lang makes good use, and in an easy, descriptive way tells the story of these lawless days. It is a very enjoyable book, and is written in spirit appropriate to a series dealing with the romance of empire.

The Discovery and Settlement of Port Mackay, Queensland. By H. Ling Roth. Halifax, England: F. King and Sons, Ltd., 1908.

We suppose it is no great slur on the geographical attainments of our readers, if we say that probably not one in fifty of them ever heard of Port Mackay. From this profusely illustrated volume we learn that it is situated in Lat. 21° 9′ S., Long. 149° 14′ E.; was discovered by Captain John Mackay in 1860; has a semi-tropical climate, and is surrounded by a fairly high range of forest-covered hills. The book is intended for Queensland readers, who are presumably interested in the history of the various towns and even hamlets which have sprung up in Queensland of recent years, and may be destined to have a brilliant future. Up to the present Port Mackay may be said to be happy in that it has no very remarkable history, but it is already the seat of a prosperous sugar industry. The first chapters are devoted to descriptions of the early discoveries and explorations of the east coast of Australia, mostly borrowed from the original authorities, and there are several appendices, the most important of which deal with the aborigines, national history and sport.

GENERAL.

The Moon: A Popular Treatise. By Garrett P. Service. London: Sidney Appleton, 1908. *Price 6s. net.*

This attractive book, which is thrown into the form of a colloquy between teacher and scholar, "a lady of charming intelligence," gives a description of what

might be called the geography of the moon. The characteristic appearances of the lunar surface are traced through the four quarters, the hills, ridges, "rays" and "seas" being taken up in order as they appeal to the observer. The origin of the moon is touched upon, and some discussion given of the question of the existence of a lunar atmosphere. The pictures of our satellite in its various phases are remarkably beautiful, being reproductions of photographs taken at the Yerkes Observatory, to the director and staff of which the author renders his most grateful acknowledgments.

BOOKS RECEIVED.

We have received the following books and reports :—

Impressions of India. By Sir Henry Craik, K.C.B., M.P. Crown 8vo. Pp. viii + 251. *Price 3s. net.* London: Macmillan and Co., 1908.

Selections from the Travels and Journals preserved in the Bombay Secretariat. Edited by George W. Forrest, C.I.E. Large 4to. Pp. xxviii + 304. *Price 10s. 6d.* Bombay, 1906.

The Eruption of Pelée: A Summary and Discussion of the Phenomena and their Sequels. By Angelo Heilprin. Illustrated. Large 4to. Pp. viii + 72. With forty-two full-page Illustrations. Printed for and presented by the Geographical Society of Philadelphia. Philadelphia, 1908.

The Misty Isle of Skye: Its Scenery: Its People: Its Story. By J. A. Macculloch. Crown 8vo. Pp. viii + 320. *Price 4s. net.* With Map and twenty full-page Illustrations. Edinburgh: Oliphant Anderson and Ferrier.

A Guide to Zermatt and the Matterhorn. By Edward Whymper. Crown 8vo. With seventy-eight Illustrations and Maps. Pp. xiv + 224. *Price 3s. net.*

A Guide to Chamonix and the Range of Mont Blanc. By Edward Whymper. Crown 8vo. Pp. xiv + 206. *Price 3s. net.* London: John Murray, 1908.

The Imperial Gazetteer of India. New Edition. Published under the authority of His Majesty's Secretary of State for India in Council. Vols. v. to xiv. Demy 8vo. Complete in twenty-six vols. Cloth. *Price £5 net.* Oxford: Clarendon Press, 1908.

Handbook of the Cayman Islands, 1908. Pp. 82. *Price* 1s. 6*d.* By George S. S. Hirst, M.B. Jamaica, 1907.

Official Year-Book of the Commonwealth of Australia containing authoritative Statistics for the Period, 1901-1907. By G. H. Knibbs. Pp. xviii + 931. Melbourne, 1908.

Jaarverslag van den Topographischen Dienst in Nederlandsch-Indië over 1907. Pp. 176. Batavia, 1908.

Year-Book and Record of the Royal Geographical Society for 1908. London, 1908.

The Edinburgh University Calendar, 1908-1909. Printed and Published for the University by James Thin. Edinburgh, 1908.

Résultats du Voyage du S.Y. Belgica en 1897-1898-1899, *sous le commandement de A. de Gerlache de Gomery. Rapports Scientifiques.* Eleven parts. Anvers, 1908.

Publishers forwarding books for review will greatly oblige by marking the **price** *in clear figures, especially in the case of foreign books.*

THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE INFLUENCE OF THE NATURAL FEATURES AND GEOLOGY OF SCOTLAND ON THE SCOTTISH PEOPLE.

By Ralph Richardson, F.R.S.E., President, Edinburgh Geological Society.[1]

1. *Orography.*—When we look at an orographical map of Scotland,[2] we become aware of how much it consists of mountains and uplands, and how little of moderate elevations. Including among the latter all areas under 500 feet above sea-level, we find that these comprise the lower part of Tweeddale, the coasts of the Solway Firth, the northern seaboard of Ayrshire, the lower part of Clydesdale, the tract from Glasgow to the Firth of Forth, and from thence past Edinburgh to Dunbar, the south end of Loch Lomond, the lower reaches of the Forth and Teith, the greater part of Fife, Strathmore, the east coast from Dundee to Aberdeen, Banff, Inverness, and Dornoch, Caithness, Orkney and Shetland, the west coast of Sutherland and Ross, the greater part of the Outer Hebrides, and some portions of the inner islands. All the rest of Scotland, probably three-fourths of the whole kingdom, consists of mountains and uplands.

2. *Geology.*—These orographical features of our country are, of course, largely due to its geological structure, the more ancient and harder rocks forming the principal mountains and uplands, while the

[1] Presidential Address delivered before the Edinburgh Geological Society, 20th November 1907.

[2] The orographical, geological, and population maps in the *Royal Scottish Geographical Society's Atlas of Scotland*, published at the Edinburgh Geographical Institute in 1895, will be found most instructive.

more modern and softer rocks have been denuded into plains and valleys, relieved as these often are by picturesque hills and crags created by volcanic action. Thus, the southern uplands, stretching from St. Abb's Head to Loch Ryan, are formed of rocks of Silurian age, while a parallel line of heights to the north, stretching from the outskirts of Edinburgh to Ayrshire, belong chiefly to the Old Red Sandstones, a formation which comprises the Ochils and Sidlaws. In the West and North of Scotland the great mountain masses belong to the Metamorphic rocks of the Highlands, while the Basalts of Mull and Skye, and the Gneiss and Torridonians of Western Sutherland and Ross, produce elevations in these districts.

3. *Races.*—The orography and geology of Scotland account for much of its ancient history and racial divisions. Mountains form the greatest barriers to migration, and races surrounded by mountains are isolated and develop distinct psychological characteristics. Low-lying, fertile countries, however, invite invasion. In this way we can understand a wave of migration surging from the south and passing across the low-lying lower valley of the Tweed, and then northwards along the coast till it reached Edinburgh, which thereby became a city of the great province of Northumbria, which in the seventh century stretched from the Firth of Forth to the Humber. Similarly, we can understand another wave passing northwards from Cumberland and spreading westwards along the Solway coast from Dumfries to Stranraer. Again, we can see how the original Scots left the north of Ireland and colonised the low-lying districts of Argyll. But from the fact that mountain masses severed these three early invaders of Scotland, we can also understand how each body of immigrants remained isolated and developed characteristics peculiar to itself. Indeed, we might hazard the opinion that if there had been no Cheviots and no great tract of moorland covering the uplands on their northern flanks, there might have been no Scotland and no special Scottish nation. To this day there is as distinct a difference between the English to the south and the Scots to the north of the Cheviots, as there is between the English of Lancashire and the Irish of County Wicklow, proving that an expanse of hilly moorland can be as effective a racial barrier as an expanse of sea.

4. *Ancient Provinces.*—Under the early kings of Scotland the province of Lothian, with Edinburgh as its capital, was inhabited by southern immigrants who, crossing the Tweed, had driven before them the Celts (whose place-names still attest their original presence) and had occupied the low-lying country on the coast northwards to the Firth of Forth. This was a race of a strong Anglo-Saxon type, which characterises the people of lower Tweeddale and the Lothians to the present day. Quite another race was found in the country lying between the Solway Firth and the mountain barrier to the north. This was a Celtic race, and their country, which was known as Galloway, still presents racially its old characteristics. Further north across the hills, but also comprising the low-lying country around Carlisle, was the Kingdom of Strath

Clyde, with Dumbarton as its capital, and this was also tenanted by a Celtic race occupying chiefly the low country stretching from Ayrshire to Clydesdale and the Lennox. To this day, the intensely Scottish type of Scotsman (who, with his *perfervidum ingenium Scotorum*, quivers when "English" is used for "British") is found in the old Celtic kingdom of Strath Clyde, while the more Anglicised type is found in the Anglo-Saxon Lothians. On the extreme west was another Celtic race which occupied Argyll, and came from Ireland, bringing with it both a language and religion differing from those elsewhere in Scotland. On the northern shores of the Firth of Forth was the province or kingdom of Fife, also low-lying and enclosed by uplands on the west and by the sea on the south, north, and east; the people of Fife from long isolation and intermarriage possessing characteristics of their own to this day. Then, following the coast northwards, was the province of Angus, stretching from the Firth of Tay northwards to the Grampians and the river Esk, after which came the province of Mernis (or the Mearns) from the Esk to Aberdeen. The north-eastern corner of Scotland was occupied by the provinces of Buchan and Mar, while to the west and north was the province of Moray which lay to the south of the firth of that name. To the north of the Moray Firth was the province of Ross, further north that of Sutherland, and furthest north that of Caith or Caithness. As the provinces which occupied the north-eastern seaboard of Scotland lay directly opposite Scandinavia, they received many immigrants from that quarter. With regard to the rest of Scotland, all mountainous or of considerable elevation, it was not divided into provinces with distinctive racial characteristics but was inhabited, in the Highlands, by clans of Celtic origin, and in the Lowlands by border families derived from the Anglo-Saxon stream which set in so strongly from the south.

5. *Racial Origins.*—We see then that, from very early times, the population of Scotland was divided into districts largely due to the orographical structure of the country which was, as already described, the result of its geological history. As Dr. Skene remarks in his work on *Celtic Scotland*,[1] "The great natural features of a country, so mountainous and intersected by so many arms of the sea as that of Scotland, appears at all times to have influenced its political divisions and the distribution of the various races in its occupation. . . . The same great leading boundaries, the same natural defences, are throughout found occupying a similar position and exercising a similar influence upon the internal history of the country." Or, turning to a distinguished geologist, Sir Andrew Ramsay, we find him saying that "the oldest tribes now inhabiting our country, both in Scotland and in the south, are to be found among those most ancient of our geological formations, the Silurian rocks, which, by old palæozoic disturbance, form the mountain lands, while the lower and more fertile hills, the plains, the tablelands, and Scotland south of the Grampians, are chiefly inhabited by the descendants of the heathen of the Northern Sea, who made good their places by the sword after the

[1] Volume i. p. 7. Published by Edmonston and Douglas, Edinburgh, 1876.

departure of the Romans."[1] Thus, in the origins of the Scottish race, Geology played a conspicuous part, and although roads and railways have since opened up the whole country and led to an intermixture of population, yet for centuries each district possessed its own racial characteristics which to some extent remain to this day. A story is told of a stranger arriving, in pre-railway days, in a district of Dumfriesshire and begging the people there, who regarded him with some suspicion, to give him a night's lodging, if they were Christians. "Na, na," was the reply, "we 're a' Johnstones and Jardines."

6. *Cradle of the Scots.*—A race is influenced by its origins. The cradle of the Scottish race was no land of boundless fertile plain or eternal sunshine, but

> "Caledonia, stern and wild,
>
> . . . . .
>
> Land of brown heath and shaggy wood,
> Land of the mountain and the flood,"[2]

a region of endless hills, of universal moorland, save where, by the energy of man, a harvest was wrung from the reluctant soil. A race cradled like this is bound to be a strong, self-reliant race, peopling a land where none could live who did not work, and where the law of the survival of the fittest operated with tremendous force. Thus the geology which produced the orography of Scotland produced the hardy Scotsman, type of a race fitted to endure the severest climates and undergo the greatest privations which the world could show, and able to hold its own with the strongest in body or brain. It is needless to attempt to recite the roll-call of Scotsmen who have distinguished themselves all over the globe as explorers, colonists, pioneers of science, captains of industry, or heroes in war. We have only to point to their rude Scottish cradle and their character and success are explained.

7. *Influence of Nature.*—Having now considered the physical features of Scotland and shown how these affected the distribution of its races, I desire to develop the subject and to inquire whether and how far other characteristics of the Scottish people have been influenced by their natural surroundings. Although it may be true, as Goethe has remarked, that "Man occupies his supreme place for the very purpose of obtaining command over Nature, and freeing himself and his fellow-creatures from the violent force of Necessity," yet Nature seldom loses her command over Man, and, being ever with us night and day, exercises an influence over us which is all the greater because it is so imperceptible that we do not even think of resisting it. Thus, a man resident in a crowded mart becomes naturally active, ready, and acute, whereas one living in the country is probably quiet, pensive, and slow.

8. *Population.*—The idiosyncracies of mankind are largely the result

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[1] *Physical Geology and Geography of Great Britain.* Third ed., p. 289. Published by E. Stanford, London, 1872.

[2] Sir Walter Scott.

of their natural environment. Take, for example, the population of Scotland, more than half of which resides in six cities. Look at a map showing by various shades of colour the density of population throughout Scotland. How comes it that there is such a very deep shade of colour (indicating from 300 to above 500 persons to the square mile) in the district between the Firths of Clyde and Forth and stretching from Glasgow to Edinburgh? It is not owing to the fertility of the district, for that is often poor. Turn to the geological map of Scotland for a reply. There we find that Glasgow is the metropolis of a huge coalfield, and Edinburgh that of a lesser one. We find iron ore accompanying the Glasgow coalfield. We find oilshales and their resultant paraffin works to the west of Edinburgh. We find, in conjunction with these mineral fields, railways, canals, ironworks, shipbuilding, and manufactories, all the result of the wealth produced not from above but from below the surface of the ground. Therefore, we understand how villages, towns, and cities sprang up, and how a population culminating in above 500 souls to the square mile was ultimately accumulated.

9. *Effect of Minerals.*—Like every other animal, Man goes where he obtains his food-supply most easily. Before the great mineral fields, to which I have referred, were discovered and developed, the population of Scotland was sparsely scattered throughout its more fertile parts because its inhabitants lived by agriculture. In the days of Wallace, towards the close of the thirteenth century, Glasgow, now a city of over 760,000 inhabitants, consisted of a single street. Towns situated in fertile valleys, like Jedburgh or Dumfries, were then more important. The Highland straths were dotted with the dwellings of crofters, as the Lowland haughs were occupied by those of yeomen. But the discovery and adaptation of coal, iron, and shale changed all this. Immense works offering constant and well-paid employment attracted population from all parts of Scotland. The Highlander left his glen and the Lowlander his dale to participate in the golden era which the dusky products of the pit produced, and which converted Scotland from one of the poorest into one of the richest countries of the globe.

10. *Geology's Boon.*—Thus geology, in its connection with economics, bestowed upon Scotland the greatest industrial and financial boon it had ever received. Indeed, without its coal and iron, where would the wealth and importance of Scotland have been to-day? There would have been no Glasgow with its teeming population, its unrivalled shipyards, its thousand factories. The Clyde would have been as silent as the Shannon, and the Firth of Forth as deserted as Bantry Bay. Had Scotland been a purely agricultural country it would have been what Ireland is to-day—a country too poor to be able to feed her own children, who, emigrating to foreign shores, find there the employment their own island cannot give.

11. *Building-stones.*—While emphasising the effect of coal, iron, and shale in giving employment and wealth to Scotland, do not let us forget the other important gifts to our country provided by Economic geology.

Few countries have such abundance of stone, whether for building or roadmaking, with the result that Scottish houses and towns are invariably built of stone, and Scottish roads are easily made and repaired. Contrast with this the dingy brick-built towns of England where architecture with such materials seems impossible, and the difficulty of maintaining roads in districts south of the Tweed where the rocks are friable. When the Houses of Parliament were built after the fire of 1834, ignorance of the splendid building stone of Scotland, notably that of Craigleith, led to the selection of a soft stone from Derbyshire,[1] with the result that the Houses soon presented the appearance of a picturesque ruin. Curiously enough, William Smith, "Father of British Geology," was a member of the Selection Commission. The stone derived from Normandy of which Buckingham Palace is built is so soft that it has to be painted to prevent its crumbling away.[2] Yet that is our Sovereign's residence. Those who have seen Aberdeen, more particularly the fine addition to its University, know how well granite lends itself to architectural treatment; but all over Scotland we find sandstones, whether white or red, which impart dignity to any town. In this connection, I should also mention the valuable slate quarries throughout Scotland which have led to her old thatched and often turf-built houses in rural districts being converted into stone-built and slated cottages.

12. *Peat-mosses.*—Then, besides building-stones, economic geology provides Scotland with peat-mosses, which, as yet supplying only local requirements, may some day prove valuable in connection with manufactures. The Moor of Rannoch alone is said to cover 400 square miles of that great expanse of diorite on the frontiers of Perthshire and Argyll. During the coal famine of 1873 I visited Hoogeveen in the north-east of Holland, and afterwards reported on the great industry I saw there in peat-fuel, of which many millions of tons were annually produced throughout Holland, and formed an absolutely necessary element in Dutch manufacturing and domestic life.[3]

As the wild rivers of the Scottish Highlands are being "harnessed" by the modern Zeit-geist Electricity and compelled to do work after running idle so long, so it is stated that, in conjunction with peat, electricity is to play a great part in one of the new industries of Argyll. Thus, while some geological products have led to the depopulation of rural Scotland, others are helping to bring population back to the long-deserted Highlands.

13. *Mining.*—It is evident that the employment afforded by processes of labour connected with mining, building, or engineering must greatly affect the character of those engaged in them. While economic

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[1] *Economic Geology*, by Dr. David Page, p. 76. Published by W. Blackwood and Sons, Edinburgh, 1874.

[2] The First Commissioner of Works (Mr. Harcourt) in House of Commons, 8th April 1907. He stated afterwards that this stone came from Normandy.

[3] *Trans. G.S.E.*, vol. ii. pp. 205 and 275. *Peat as a Substitute for Coal*, by the Author. Published by A. and C. Black, Edinburgh, in 1873.

geology leads to the production of untold wealth derived from the bowels of the earth, it creates a race of mankind altogether *sui generis* and differing from any other. According to the latest Government statistics there were at work in Scotland in 1905 526 mines, under the Coal Mines Act, employing 114,294 persons, besides 32 metalliferous mines employing 974 persons. Again, there were 1127 quarries in operation employing 12,187 persons. Thus we find no fewer than 127,455 persons engaged in work connected with the removal of fragments of geological strata for economic purposes, the coal alone raised in Scotland in 1905 exceeding $35\frac{3}{4}$ million tons. These miners and quarrymen constitute a sturdy race, no doubt, but from the very nature of their calling they are often unable to take that social and intellectual position to which their numbers and general intelligence entitle them. How many of these miners study the history of the extraordinary Carboniferous period whose spoils they are daily bringing to the surface, or employ the lamp of Geology, as well as their miners' lamps, to lighten their labours in the subterranean kingdom which they explore? I do not remember a common miner ever favouring a Scientific Society with a contribution in regard to a realm where, from his daily experience of it, he must be master of us all. Only one bright conspicuous star occurs to me among quarrymen. Hugh Miller began his wonderful career by working as a mason for fifteen years in a stone quarry at Cromarty, and from the first he showed that marvellous interest in, and power of description of, geological phenomena which will for ever place him among the most famous of Scottish geologists.

14. *Agriculture.*—Let us look next at the connection between geology and agriculture in Scotland. Our first discovery will be that, while the total area of Scotland is 19,070,244 acres, only 4,873,039 acres were, in 1906, under crops and grass. Why is this? Why is only one-fourth of Scotland suitable for agriculture? The orographical and geological maps of Scotland furnish the reply; for, looking at these, we perceive that the great mass of our country is upwards of 500 feet above the level of the sea, and that that altitude generally represents the older rocks. The original elevation of these rocks, and the fact of their having been too hard to yield as much as others to the constant denudation to which the entire land surface has been subject, have enabled them to remain as the backbone or framework of our country, while, owing to their altitude, the districts occupied by these old rocks are climatically unsuitable for agriculture; whereas the more modern and softer rocks have been ground down, and form low-lying and fertile districts where agriculture may be successfully pursued. According to the census of 1901 no fewer than 209,711 persons were engaged in agriculture in Scotland, showing its importance to the nation.

With regard to the more intimate relations between geology and agriculture in Scotland, we may note particularly two deposits which, provided the local climate is good, are favourable to agriculture:—

Firstly, deposits of volcanic ash ejected from ancient volcanoes, which, as in East Lothian, invariably produce a fertile soil; and

Secondly, deposits of glacial age which, consisting of the various ingredients of the rocks removed and mixed by the moving ice, often form, as in Midlothian, soils possessed of fertility and strength. The tracts adjoining rivers, consisting of gravel and sand deposited by fluviatile agencies as in Tweeddale, are favourable to agriculture; while the "raised beaches" which occur all around our coasts produce, as in the Carse of Gowrie, some of the finest agricultural districts in Britain. Thus geology and agriculture are closely linked, and as we may look to the miner for a description of the bowels of the earth, so we may also ask the farmer to describe its surface. One of these, Mr. James Melvin, Bonnington, Ratho, did, in 1887, remind us of the deep interest taken in it by the founder of the Scottish School of Geology, James Hutton, who wrote about 1795 a *Treatise on Agriculture*, the manuscript of which Mr. Melvin presented to the Library of the Edinburgh Geological Society. In his address Mr. Melvin discussed, as a practical farmer, Hutton's *Treatise*, and came to the conclusion that the philosopher had anticipated in no small degree the agricultural theories of the thirty years preceding 1887. Mr. Melvin, who was President of the Scottish Chamber of Agriculture, had likewise discussed, in 1877, the "nature and origin of the Surface or Vegetable soil," and strongly advocated a careful survey by Government officials of the soils and subsoils of our country, which, he added, were all derived from the subjacent rocks.

15. *Natural Features and Population.*[1]—I have endeavoured to point out the part geology has played in giving Scotland extraordinarily valuable mineral fields with their concomitant industries, and I have shown how closely it is connected with the agriculture which has, in our country, been often carried to the highest perfection. The influence of the natural features of Scotland on the Scottish people is the result of the various agencies whose operations are revealed by the science of geology. While the history of the Carboniferous period explains the growth of coal and the formation of vast mineral fields, so the history of the Post-pliocene period reveals the formation of the superficial deposits on which agriculture is pursued. And, just as the population of the mining districts is distinct in character from that of the agricultural, so the geological deposits of the one are distinct from those of the other.

16. *Influence of Scenery.*—But geological scenes, otherwise termed natural features, have other influences upon mankind. We possess in Scotland all manner of scenery, all the result of well-known geological agencies: we have, for instance, the solemn influences of the Gneissic country, the pleasing variety of the Old Red rocks, the impressive grandeur of the Grampian Hills, the exquisite beauty of lochs and tarns, the billowy expanse of the southern uplands, and the picturesque vestiges of volcanic activity. As he enters each of these scenes, the geologist knows its history from the rocks around him; he recognises their age and whether they are, geologically speaking, ancient or modern; he

[1] *Trans. Edin. Geol. Soc.*, vol. v. p. 468.

understands from the nature of the rocks themselves what the effect of denudation upon them would be; and thus the scenery before him is no incomprehensible, haphazard creation, no result of *diabolic* interference, as the formation of so many of our picturesque scenes have been traditionally attributed to, but an easily-explained phenomenon obedient, like everything else in Nature, to the immutable laws of Cause and Effect.

"Nach ewigen, ehrnen,
Grossen Gesetzen."[1]

17. *Gneiss.*—To illustrate these remarks, I shall pass before you on the screen a few typical examples of Scottish scenery,[2] and shall point out the salient features of each from a geological point of view, connecting each scene with the name and portrait of some eminent geologist who was renowned for his researches among the rocks described.

I proceed first to the North-West Highlands and present a view of Suilven (2300 feet high) taken from Inverkirkaig, as sketched by Mr. H. M. Cadell,[3] showing also the summit of Canisp (2786 feet high), and the platform of iceworn Gneiss in front of Suilven. We are in Sutherland, and the hills before us consist of Torridon Sandstone rising above Gneiss. Could any scene be more weird or awe-inspiring? Could human beings born and nurtured here fail to imbibe, from their natural surroundings, some traits of Nature in her gloomiest and most solemn mood? The Germans have a saying that living in a Basalt country is conducive to piety. May the same theory perhaps apply to the Gneiss? As a matter of fact, the inhabitants of this part of Scotland have always been noted for their piety, and for their attachment to religious principles as primitive and enduring as the Gneiss is among rocks.

As a pioneer of the geology of the North-West Highlands, no one is more worthy of recognition than Mr. Charles William Peach, whose discovery of the Durness fossils in 1854 places him among the first to elucidate one of the most complicated geological provinces in Scotland. I give you the portrait of this fine old geologist, whose genial presence I knew so well, which appeared in Dr. Samuel Smiles' *Life of Robert Dick of Thurso*,[4] Peach's intimate friend.

18. *Old Red.*—I turn, in my second picture, to more gracious scenes than occur in the North-West Highlands,—those of the Old Red rocks. Here, owing to the crumbling character of the strata, their ruddy glow, and the profuse vegetation which bedecks the course of their streams, which leap over a thousand cascades in their silvery course, we realise Burns's lines (which long preceded those of Tennyson's "Brook"), beginning:

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[1] Goethe, *Das Göttliche.*

[2] *Cf.* the illustrations of Scottish scenery which accompany Sir Archibald Geikie's article on "The History of the Geography of Scotland," vol. xxii. p. 117 *et seq.*—Ed.

[3] *The Geology and Scenery of Sutherland*, 1896, p. 28. Published by David Douglas, Edinburgh.

[4] Published by John Murray, London, 1878.

"Whyles owre a linn the burnie plays,
As thro' the glen it wimpl't;
Whyles round a rocky scaur it strays,
Whyles in a wiel it dimpl't."

If ever a man had an eye for scenery Robert Burns had. I give an example of Old Red rocks with which the poet must have been familiar when he visited Jedburgh. It is a view of the river Jed near the classical section where Hutton found horizontal Red Sandstones overlying vertical Silurians.[1] Scenes such as these beget poets and literary men. This is the country of Thomson, Leyden, and Walter Scott. I have heard it said that Roxburghshire has produced more literary men of note than any other county in Scotland; and although it is certainly a land of romance in its history and legends, we must not forget that romantic scenery is the parent of romantic tradition and literature.

The city of Perth is surrounded by rocks, both sedimentary and eruptive, of Old Red Sandstone age. Resting on a "raised beach" of marine origin, Perth holds the gorge formed by the river Tay through Old Red rock-masses. This gorge was, and is, the key to the Perthshire Highlands, and thus the importance of Perth, the original capital of Scotland in historical times, is capable of explanation: for the city became the emporium of the immense area drained by the Tay, the most magnificent river in Scotland.

There is no more impressive view than that which the English traveller Pennant called "the glory of Scotland," and which Sir Walter Scott declared was unequalled "in Britain, or perhaps the world,"[2]—the renowned view obtained on approaching Perth from the south, and which embraces the whole range of the Grampians which are seen rising from the basin of the Tay and its tributaries.

These lofty sentinels of the Caledonian race, which defied even the Romans to cross them, belong to the primitive crystalline rocks, at whose base once stretched a vast lake, now represented by the Old Red Sandstones.

If geology is an exponent of events which are occurring around us every day, it also treats of those whose antiquity is so great as to be utterly beyond the finite mind of man to fathom, and which can only be associated with that of the Infinite to whom "a thousand years are as one day."

The mere mention of the Old Red Sandstone recalls the name of one who added all the charms of imagination and literary style to a thorough knowledge of this province of geology—Hugh Miller—who lived long among the Old Red Sandstones of Cromarty, and whose book on them was the first and, in the opinion of Sir Archibald Geikie, "the freshest and most delightful of all his scientific volumes."[3]

Another pioneer of geology in the same field was Dr. John Fleming, Professor of Natural Philosophy in the University of Aberdeen, who was

[1] Hutton's *Theory of the Earth*, published in 1795, vol. i. p. 456 (Plate III.).
[2] *Fair Maid of Perth.*
[3] *Landscape in History*, p. 271. Published by Macmillan and Co., 1905.

not only the first to discover fish remains in the Old Red, but also the first to announce that the Old Red is a freshwater formation.[1] Dr. Fleming, when minister of Flisk on the Firth of Tay, made zoological and meteorological observations of great interest and value.

19. *Metamorphic Rocks.*—At the same time, there have always been two Scotlands, separated historically by the river Forth, the northern Scotland being as conspicuous for its Highlands as the southern is for its Lowlands. If you look at a geological map you will find a vast area extending from the south of Argyll to the north of Sutherland covered by what are known as the "Metamorphic Rocks of the Highlands," being rocks which have undergone such changes within the earth's crust that their original character has been greatly altered. The Scottish Highlands consist mainly of crystalline rocks which, from fossils, have been identified as Lower Silurian in a metamorphosed condition. Entering the Highlands with their crumpled and plicated mica and chlorite schists, their gneiss, clay slates, and quartz rocks, with their sharply defined mountains and their peculiar vegetation, we enter a world entirely different from that of the Scottish Lowlands. Is it surprising that the people of the Highlands should be different too?

The scene before us (Ben More) is a Highland one, and depicts the veritable "Land of the Mountain and the Flood." No miner looks for employment here, for there are no minerals. No farmer comes here for agriculture, for the land is too infertile and rocky, besides being at too great an altitude. But here that grand specimen of the Scottish race, the Highlander, has been born and reared, and from hence he has often borne to the uttermost ends of the earth that Celtic vigour and Celtic fire which have carried the name of Scotland to the highest success in the walks of peace, and to the greatest glory in the art of war.

As emblematic of that race, and as one who, when Director-General of the Geological Survey, studied the Highland rocks with lifelong zeal, I give the portrait of Sir Roderick Murchison, whose biography by Sir Archibald Geikie is one of the best historical works in geological literature.[2]

Sir Roderick was an ardent and celebrated geologist, although his views regarding the geology of the North-West Highlands have been overthrown by later observers, as shown in the recent magnificent Memoir of the Geological Survey,[3] the result of nearly a quarter of a century's field-work.

20. *Silurian Uplands.*—Pass from the Highlands to the Lowlands. When Washington Irving visited Sir Walter Scott at Abbotsford, his host took him to a place whence he could view the surrounding hills; and when Irving gazed at their long, smooth, bare, undulating outlines, he declared that he believed that a stout fly might have been seen if it

[1] "Old Edinburgh Geologists," *Trans. Edin. Geol. Soc.*, 1894, vol. vii. p. 87.

[2] Published in two volumes by Murray, London, in 1875.

[3] *The Geological Structure of the North-West Highlands of Scotland* London: H.M. Stationery Office, 1907).

had crawled along their profile. These are the well-known Silurian Uplands of Lowland Scotland, and a distinguished President of this Society, now President of the Geological Society of London—Sir Archibald Geikie—said he loved them in all their native bareness, and protested against clothing them with woodland, maintaining that you might as well put the Apollo Belvedere into a greatcoat.[1] How different was Burns's "Humble Petition of Bruar Water"!

The Silurian Uplands have been described as the wreck of a former tableland, denudation having carved and planed it into those hills and valleys whose flowing lines are so familiar to us. The originator of the now well-established doctrine of land-sculpture is said to have been Desmarest, who, in 1765, made the same observations among the hills of Auvergne as we can do among those of Scotland.[2] He was followed by De Saussure and our own illustrious James Hutton, whose *Theory of the Earth* was so lucidly expounded by Professor Playfair of Edinburgh. They all attributed the sculpture of the land to subaerial denudation, consisting of the action of water in its various forms. Then, in addition to all the ordinary subaerial agencies, the southern uplands were subject to glaciation sometimes long and severe, and this of itself would account for the mammilated summits and undulating slopes. Yet on these bleak hill-sides and moorlands was reared as vigorous a race of men as ever existed—the celebrated Borderers, so well known in the pages of history and romance. From the very circumstance that their land was poor, while on the English side of the Border fertility and plenty co-existed, incursions from the Cheviots to the southern country took place from the earliest times. In vain the Romans built a wall from Tyne to Eden to stem the invasions of the Northern barbarians. In vain the Lord of the English Marches endeavoured to stop the Scottish Borderers' raids, for, as Shakespeare made King Henry V. say of his great-grandfather, he—

> "Never went with his forces into France,
> But that the Scot on his unfurnished kingdom
> Came pouring, like the tide into a breach,
> With ample and brim fulness of his force:
> Galling the gleaned land with hot essays;
> Girding with grievous siege castles and towns;
> That England, being empty of defence,
> Hath shook and trembled at the ill neighbourhood."[3]

It was Poverty and Hunger striking at Prosperity and Plenty, and a glance at the barren lands on the Scottish side of the Borders, the result of the infertile Silurian Uplands, compared with the rich Permian valleys on the English side, explains the ceaseless flow from North to South.

I give a picture of Abbotsford, with a distant view of the Silurian

[1] *The Scenery of Scotland.* Second Edition, 1887, p. 295, published by Macmillan, London.

[2] "The Origin of Landscape," in *Edinburgh Review* for October 1806.

[3] *King Henry V.*, Act I. Scene 2.

Uplands, from whence in olden days the Scots periodically swept down upon their richer neighbours of England, burning their houses, seizing their cattle, and carrying north as slaves so many of their inhabitants that it was said at one time that there was not a house on the Scottish side of the Border which did not contain an English slave.

Although James Hutton was born in Edinburgh, he for many years lived on his property in Berwickshire, and had daily before his eyes those hills whose geological history he knew so well, and regarding which an earnest student of Nature expressed true Huttonian sentiments in the well-known lines :—

> "The hills are shadows, and they flow
> From form to form and nothing stands ;
> They melt like mist, the solid lands,
> Like clouds they shape themselves and go."[1]

21. *Glaciation.*—The next picture brings us face to face with a problem of Scottish geology which has been elucidated by many great Scottish geologists of our own day. To illustrate it I present a view of the so-called "Queen of Scottish Lakes," Loch Lomond, whose origin was due to no sudden convulsion of Nature, but to the slow, grinding eroding power of ice which excavated a rock-basin, now filled with water, and produced a lovely loch. Similar lochs are found all over Scotland, and their formation is due to geological agencies which, long misunderstood, have been explained by distinguished Scottish glacialists, and are now generally recognised. Thus, owing to our country having been traversed by ice, its surface has been pleasantly diversified in every direction by lakes which impart often great beauty to the scenery, while furnishing thousands of visitors with enjoyment and sport. Truly Scotland, especially the Highlands, without lochs and their attendant rivers, would be like a body without a soul; for they impart to it life and animation and that picturesque beauty which our artists delight to portray. However much it may have excelled in other branches, Scottish art is especially the delineation of Scottish scenery, and nowhere does landscape afford more scope for art than in "Bonnie Scotland," with its ever-changing sky, its lochs and rivers embowered in graceful woods, and encircled by majestic hills. Nasmyth, Horatio M'Culloch, Thomson, Williams, Sir George Reid, M'Whirter, Graham, and many others came under the soft and subtle influence of their country's landscape, and made this province of the Scottish School of Painting one of the most delightful in the world.

A very beautiful reference to the influence of Nature on the people of the Scottish Highlands, even in their hand-spinning trade, was recently made by that distinguished and ardent supporter of Scottish Home Industries, Her Grace the Duchess of Sutherland, when she said : "There is something, if we can carry our imaginations so far, that speaks of all the sunrises and sunsets of Nature, all the blues and

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[1] Tennyson, *In Memoriam*, cxxiii.

browns and greens that we, who live in the Highlands, know so well in our mornings and noondays and evenings, in the texture and in the colouring of this cloth; and it is hardly to be wondered at if these people, who are so far from the haunts of men, are in constant communication with Nature."[1]

In connection with the glaciation of Scotland there is one name which springs to the lips of every Scottish geologist, and that is the name of the genial and world-renowned Professor of Geology in the University of Edinburgh, Professor James Geikie, whose works on the subject, notably *The Great Ice Age*, gave the greatest impetus to the glacial theory that it had received since the days of Agassiz. I venture to add a sketch by myself of Roches moutonnées (glaciated rocks), near the Grimsel in Switzerland, and on Corstorphine Hill near Edinburgh, as proving that the same glacial influences were at work in Switzerland and Scotland during the glacial period.

22. *Volcanic Rocks.*—Perhaps no geological agents have been more productive of picturesque scenery than the outbursts of volcanic energy which have frequently occurred during the geological history of Scotland. Think what a bare, monotonous plain many a district would have been but for those picturesque crags and hills, for which we are indebted not to Neptune but to Pluto. Take the district in which we are met at this moment. Here we have an area of Carboniferous rocks denuded into a smooth undulating surface and themselves presenting no scenic attractions. Fortunately, however, that Carboniferous area had been pierced in many places by eruptive rocks sufficiently hard to resist the denudation to which the softer sedimentary deposits had succumbed. It is to these rocks that Edinburgh owes the unsurpassed beauty of her site, for where would the world-wide acknowledgment of the charms of her situation have been without the Castle Rock, the Calton Hill, Arthur's Seat, Salisbury Crags, Blackford Hill, the Braid Hills, the Pentlands, Corstorphine Hill, and many other volcanic eminences which, rising at intervals with almost theatrical effect, lend to the capital of Scotland a picturesque setting with which no city with which I am acquainted can even distantly vie.

Even allowing for the glamour with which her history and intellectual associations invest her, I will venture to say that the beauty of the situation of Edinburgh, due as I have shown to geological considerations, must always have a powerful effect upon the imagination; and that when the greatest of her sons hailed her as

"Mine own romantic town!"

he was influenced as much by her glorious physical attributes as by the halo of historic romance with which she has for centuries been crowned.

Or, consider how Arthur Hallam was inspired by the natural features of Edinburgh when he wrote of her

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[1] Speech at opening of Exhibition of the Scottish Home Industries Association at Liverpool on 26th November 1907.

"Vicinage
Of clear bold hills that curve her very streets,
As if to vindicate, 'mid choicest seats
Of Art, abiding Nature's majesty;
And the broad sea beyond, in calm or rage
Chainless alike, and teaching Liberty."

If such was the influence exerted by the natural features of Edinburgh on the mind of a passing English visitor, how much more deeply should they affect those who permanently reside there!

It is impossible for any artist to do justice to the manifold beauty of Edinburgh, for no canvas is large enough to take in adequately her extraordinarily wide and varied assemblage of hills and rocks and encircling sea; but I present as good a view as any I have seen, drawn by that well-known Scottish artist, Hugh W. W. Williams, who died in Edinburgh in 1829. He is best known as "Grecian Williams," for he painted many pictures of Athens, the site of which, in his opinion, resembled, but was never to be compared for beauty with, that of the Modern Athens, as Edinburgh has been called.

During a visit to Athens last May I had an opportunity of noting the geological structure of its environs, the rocks of which are mainly limestone and schists, with an expanse of alluvium. Such a geological structure would never produce a landscape of such varied beauty as distinguishes the Scottish metropolis, which is largely dependent on its eruptive rocks for its scenic effects.

The rocks of Edinburgh were described by a distinguished local geologist, Charles Maclaren, Editor of the *Scotsman*, who dedicated to the members of the Edinburgh Geological Society the second edition of his classic work on the *Geology of Fife and the Lothians*. He died before it was published in 1866,[1] and the proof-sheets were revised by another eminent President of that Society, Dr. David Page.[2] I give the portrait of Charles Maclaren, whom I knew very well, as I did also Dr. Page, under whom I first studied geology. I also present Charles Maclaren's geological diagram of Arthur's Seat, taken from the work I have already referred to; and a curious map by Mr. H. M. Cadell indicating, from geological evidence, the extensive lakes which in ancient times existed in the vicinity of Edinburgh.[3]

I have attempted in this address to show the influence which the natural features of Scotland have exerted in the formation of the character of the Scottish people. To understand the natural features of a country we must begin by acquiring a knowledge of its geology. From thence we proceed to its orography and physiography, its mineral wealth, its agricultural possibilities, and its climatic records. Thus geology forms the basis upon which the other sciences rest, whereby we

[1] By Adam and Charles Black, Edinburgh.

[2] Dr. Page's numerous geological works were published by William Blackwood and Sons, Edinburgh.

[3] *Scottish Geographical Magazine*, 1893, p. 302.

learn not merely the economic value of the country but the probable characteristics of its population.

Geology has long been supposed to confine itself to the strictly scientific consideration of rocks, minerals, and fossils, but it has a wider sphere. It can tell what country will be rich and prosperous, or remain poor and barren. It can look below marsh and moorland, below veldt and desert, and discover wealth greater than Crœsus ever dreamt of. Or, it can stay the step of the emigrant or the pick of the prospector in lands which its investigations declare to be unprofitable. Similarly, it enables us to comprehend the characteristics of populations by unfolding the natural features of the districts which they respectively occupy, and under whose influence they perpetually live.

THE MISSISSIPPI RIVER PROBLEM.[1]

By Walter Sheldon Tower, Ph.D., University of Pennsylvania.

The project for a deep waterway from the Great Lakes to the Gulf has been dreamed about and discussed intermittently for half a century, but nothing definite ever came of it until a little over a year ago, when, from a conference held at St. Louis, there was born the permanent organisation called the "Lakes to the Gulf Deep Waterways Association." That this concerted movement came at the psychological moment has been indicated by subsequent events. Last winter the Rivers and Harbours Congress in session at Washington supported the project. The president in his Memphis address heartily endorsed the enterprise; shortly afterward his annual message called attention to the need for river improvement, and the question is now in the hands of Congress with some definite action sure to come in the near future.

Within the last decade, this country has entered three fields of government activity, forest conservation, reclamation of arid and swamp lands, and the building of the Isthmian Canal, the far-reaching results of which can scarcely be estimated at this time. The development of a ship channel through the Mississippi Valley, with feeding lines in the larger tributaries, would likewise be of such tremendous importance to the economic progress of the country that it must be ranked second to none in the list of great national policies.

A few simple statements of fact furnish striking evidence of the need for such a waterway. The drainage basin of the Mississippi system covers an area of approximately a million and a quarter square miles, or rather more than two-fifths of the United States proper. This two-fifths of the country is the real heart and soul of the nation's prosperity. With its development the United States has not only become independent of the rest of the world, but also has risen with tremendous strides to stand as the greatest producer of food-stuffs that the world has ever

[1] Reprinted from the *Popular Science Monthly*, July 1908.

seen or will ever see. More than half the total population of the country to-day is found in the score of states bordering directly on the navigable portions of the Mississippi system. As the population increases the most rapid growth must be in these same states, until a century hence, with hundreds of millions of people living between the slopes of the Alleghenies and the Rockies, there will exist in the Mississippi Valley the highest and most permanent type of civilisation in the history of man. Three-fourths of the world's cotton crop is raised in the United States, and the heart of the cotton belt must for all time lie in Mississippi, Louisiana and Texas. Our corn crop is three times as great as for the rest of the world combined, and, though corn is widely grown both north and south, the chief corn belt naturally centres in the Upper Mississippi and Ohio Valleys. For example, five states, Illinois, Iowa, Kansas, Nebraska and Missouri, raise over half the total for the country, or, astounding as it may seem, nearly 40 per cent. of the entire world's crop. Wheat, cattle, hogs, vast quantities of oats, hay, potatoes, lumber, coal and other mineral products come mainly from the Mississippi Valley, each one in point of quantity leading all other nations of the world, and yet no one denies that the limit of productivity is far from being reached. Out of this list, cotton, meat products and bread-stuffs make up a large part of our foreign commerce, with half the world's mileage of railroads required to get the products to the seaports. As might be expected, by far the thickest railroad net is in the Mississippi Valley, yet the roads there have found their facilities increasingly inadequate to handle the produce of the region. "Shortage of cars" has become a familiar complaint in the wheat-fields of the north-west. Corn and cotton in the states along the Mississippi have been kept out of the markets because of increased rates on rail shipments. On every side the farmers have raised the cry, "Better freight facilities," but the railroads have steadily failed to meet the demand. Conditions have gone from bad to worse, until now the harassed producers see that their only salvation lies in the development of the routes so bountifully supplied by nature, with co-ordination of rail and water facilities to prevent disastrous opposition.

It is not a case of providing merely enough to meet present needs, for the growth of this vast interior storehouse still continues with gigantic strides. Irrigation, dry farming, swamp drainage, and the exploration of the whole world to give new crop species, are opening every year areas which have heretofore produced little or nothing, while crop improvement and intelligent soil management are adding millions of bushels to the yield of the older regions. Marked by developments unparalleled in the history of the world, there seems to be no limit to the enormous capacity to produce over areas measured in tens of thousands of square miles, areas whose crops alone determine panic or prosperity for the entire nation; areas wherein lie the sinews of the greatest and most stable world power in all history. Not England, nor Russia, nor China, not any other nation or continent of the world, can equal in all its territory the unbounded natural advantages of the Mississippi Basin. Yet with each added harvest the pitch of traffic congestion and heavy transportation charges are felt by an increasing proportion of the popula-

tion, and as long as such conditions continue the full economic development of the region must be seriously hampered.

The logical solution of all the difficulties lies clearly enough in the utilisation of the great arterial system of waterways afforded by the Mississippi and its tributaries. The time was when these rivers were the life currents of the region. In the days when river craft plied the Mississippi, Missouri and Ohio are found the conditions which gave birth to, and stimulated the growth of, St. Louis, Cincinnati, Louisville, Memphis, St. Joseph, Kansas City, Omaha and a host of other river cities of all sizes. To-day these cities are railroad centres, but by that very fact of having ready-made terminals the development of the water route takes on added value. Take, for example, St. Paul and Minneapolis, at the head of navigation on the Upper Mississippi, the greatest flour-milling centres in the world, shippers of hundreds of thousands of tons for both home and foreign markets, and at the same time the logical railroad centres for a large section of our own north-west and Canada. Kansas City, almost in the geographical centre of the country and undoubtedly destined to become one of the greatest inland cities of the continent, with St. Joseph, Omaha and Sioux City, all lie in the range of former navigation on the Missouri and stand as important shipping centres for the great corn, wheat, and cattle trade of the country back of them. The vast quantities of products handled at these places are mainly bulky goods which do not suffer seriously from relatively slow transit, but which do need most urgently the means of getting to market at the lowest possible transportation charge. No better illustration of the advantage of shipment by water can be found than that afforded by the coal trade from Pittsburg to points on the Mississippi. Coal can be sent from Pittsburg to New Orleans by river, 2,000 miles, for about 75 cents a ton, while the rate by rail to Memphis, 807 miles, is over $3 per ton. On the basis of the charge per ton per mile, the latter rate is about ten times as heavy as the former, a fact which becomes strikingly significant when it is considered that a saving of a single mill per ton mile means $1,000 saved on every shipment of 1,000 tons going 1,000 miles. A similar saving on a comparatively small part of the annual cereal crop alone in those states bordering the Mississippi system would very soon reach a total surprisingly close to the entire cost of improving the navigation.

A waterway with a depth of fourteen feet from New Orleans to Chicago, with channels of less depth in the Ohio and Missouri, would almost unquestionably solve the problem of traffic congestion and high freight rates for a great area of the productive west. It would be a movement directly in line with the policies of various European nations, where far less valuable waterways in thickly settled districts have been most profitably utilised. It is an enterprise which the United States must inevitably undertake sooner or later as the density of population increases throughout the Mississippi Valley. Railroads, thoroughly equipped, yet inadequate to meet the conditions of the present time, will be relatively less able to cope with the rapidly growing demands for transportation facilities in the future. Already in the more densely

populated portions of the country waterways once abandoned are being rehabilitated. The country can not long afford to ignore the possibilities presented by the development of the greatest natural highway in the world—the Mississippi and its navigable tributaries. It can not be denied that the improvement of our greatest inland waterways will be followed by vastly more important industrial and commercial advantages than can ever result from the opening of the Panama Canal. These advantages would be not to the people of the Mississippi Valley alone, but to the people of every county and corner of the Union through their dependence on the products of this region.

The project, however, is not at all simple—it is an undertaking fraught with problems which, unless met rightly at the start, must inevitably defeat the entire purpose of improvement. Like all big rivers, the Mississippi and its tributaries have bad habits, the worst of which are devastating floods, followed by very low stages of water at other times; rapid changes in the course through sapping of the banks; and constant shifting of the channel, often over night, on account of the formation of sand bars. In these respects our rivers are not necessarily any worse than others, in fact, they are not so bad as many of the great rivers of the world, but the correction of these habits becomes an unavoidable and serious question when efficient improvement for navigation is undertaken. The question of river control and improvement is most intimately connected with forestry, farming, mining and other industries, since they in many cases largely determine the particular problems with which man must deal. In the Ohio the overwhelming spring floods and low water stages of summer are the chief difficulties, with slack water dams doing much to remedy the latter condition and make navigation possible at all times. The sand-bar evil in the Missouri is so great and so perplexing that it completely overshadows the question of flood control and sapping of banks, which are in themselves of no slight importance. Along the lower Mississippi from St. Louis to the Gulf all three problems urgently demand attention, since this portion of the river represents the trunk line of the entire deep waterways system; and it is just here that the physical conditions surrounding the river make correction or control the most difficult.

From St. Louis southward, the river course follows a broad alluvial plain, which gradually increases in width to about 100 miles near the Gulf. This broad river flat is composed of a soft, highly-productive soil, fine-grained and of indefinite depth, in which the river has developed such a tortuous course that while the air-line distance from Cairo to the Gulf is about six hundred miles, the journey by water is twice as long. On every one of the many turns and bends throughout the whole twelve hundred miles the river is constantly undermining and wearing away the outer bank of the channel in just the same way as the outer rail of a curve on a railroad is worn rapidly and must soon be replaced. The fine-grained, loose character of the soil greatly facilitates the undermining action, especially during the irresistible rush of flood waters.

This habit of eating away its banks is perhaps the worst which can

be charged against the lower Mississippi, and presents one of the most serious problems in the whole question of control. Needless to say the unceasing changing of the course is vitally important to the plantation owner, who sees his fertile land steadily vanishing, often at the rate of 300, 400 or more feet a year along his entire water front. It is still more important to the towns and shipping points located along the river. New Orleans is the only big city located directly on the river flat, and, fortunately for the city, it is at a place where the river's course is now comparatively straight. Other cities, like Memphis, Vicksburg and Natchez, are located on the high bluff where the river swings close against the eastern side of its valley. These latter towns have secured immunity from floods, but even simple changes in the channel would deprive them completely of their water fronts and strike fatal blows at their prosperity.

Even the present extent of the river traffic demands that there shall be more or fewer villages directly along the river and steamboat landings at various points, but every one of these places enjoys only a temporary existence. Since the river current hugs closely the outer side of every curve in its course, it follows that the deepest water, and hence the main channel, also lies near the outer bank. The natural result is that all steamboat landings and all important shipping points must be located on the outer banks of curves, as is found to be the case all along the river. The difficulty which lies therein is obvious enough, for with rapid undermining of the outer bank of all bends, the river is always tending to destroy the water front of every place so situated. The history of the landings below Cairo shows that practically every one of them has been driven back before the advancing river at the rate of 100 to 150 feet a year for the last quarter of a century.

That this condition is felt on a larger scale than by mere landings is shown by the case of Greenville, Mississippi. This city of nearly 8,000 people, the largest river port between Vicksburg and Memphis, is the flourishing commercial centre for an important part of the lower valley, yet imminent ruin is even now staring it in the face. Greenville stands on the outer bank of a great curve in the river with three other curves up-stream from it. Narrow necks of land separate the different curves, and these necks are rapidly disappearing as the banks cave in. Twenty-five years ago at the curve farthest up-stream from the city the neck was over 4,000 feet wide, five years ago it was less than half that width and was caving badly. The neck below the city is only half a mile wide and is also yielding rapidly to the attacks of the river. Greenville is confronted with these alternatives: If the neck below the city is cut through first by continued sapping, the city will be left high and dry, five miles from the river, and its reason for existence will be gone. If, on the contrary, the neck above the city is the first to succumb, the resulting changes in the channel will cause most vigorous scouring of the bank exactly where Greenville stands and it will be speedily swept away. The levee now stands where the main street once ran and, despite every effort to stop it, the town has been forced to play leap frog over itself to keep away from the advancing river.

Through the expenditure of a million dollars in protective devices the crisis has been delayed, yet the city is doomed eventually, and the money spent in its protection must be regarded as wasted.

St. Joseph, Missouri, with a population exceeding 100,000, one of the most important centres of the west, must face a somewhat similar fate from the Missouri river. Opposite the city the stream swings around a great bend, St. Joseph being located on the bluff above the river bottoms. Some smaller villages on the flat have already been swallowed up in the stream, and, at its present rate, the current will soon cut its way through the narrow neck which lies a few miles west of the city, severing the Grand Island railroad, rendering the big steel bridges at St. Joseph practically useless, making new bridges over the new channel necessary, cutting off the intake of the water supply, and leaving the city without any outlet for its sewer system. Here, again, somewhat over a million dollars has been spent in river work above and below the city, but the banks have continued to cave, and St. Joseph is facing the prospect of being left higher and dryer than Greenville. From the standpoint of transportation by water, however, the loss of the river front at St. Joseph would not be a serious calamity, since the Missouri route is at present rendered quite useless by the excessive formation of sand bars.

Both the federal government and the Chicago and Alton railroad have spent large sums in an attempt to control the Missouri at Glasgow. Kaskaskia, the one-time capital of Illinois, has been wiped out of existence by the changing current of the Mississippi, while the prospect of a cut-off at Cowpen Bend, above Natchez, indicates that the harbour of that city will be destroyed by the deposition of large quantities of sand along the entire water front. Striking as these individual cases may be in themselves, the question of this cutting away of the banks, accompanied by deposition of sand in other places, takes on far greater significance as soon as costly improvements are suggested. It is undeniable that what is happening along the river to-day is a true sample of what the river may be expected to do every day as long as the existing conditions prevail. A fourteen-foot channel presupposes important movements of goods from many points along the river. Large shipments cannot be handled readily or economically without expensive modern terminal facilities along the river front, but the building of such terminal facilities cannot be expected as long as they are threatened with the same fate that now confronts Greenville, Natchez and St. Joseph.

The flood evil, the second great problem to be met in the control and improvement of the Mississippi system, has been fresh in the minds of every one since the disastrous spring of 1903, when the loss of property amounted to fifty or sixty million dollars. The flood problem applies not only to the main Mississippi itself, but perhaps even more vitally to its chief tributaries, the Missouri and Ohio, which must be regarded as the main feeders to any proposed improvement. The total loss from a few historic floods in these streams has been tremendous. In 1881 and 1882 the floods of the Ohio and lower Mississippi caused

a loss of $15,000,000. In 1884 the Ohio valley alone suffered to the extent of $10,000,000. An area twice the size of New Jersey was laid waste along the lower Mississippi in the spring of 1897, with losses again reckoned in tens of millions of dollars. The unprecedented ravages of the Missouri came in May and June of 1903, and finally this last year saw damage to an extent estimated at not less than $100,000,000 in the Ohio Valley. In the last quarter of a century, therefore, the plain money loss from a single half dozen floods approaches a quarter of a billion dollars, while the sum total from all floods must be acknowledged to equal many times over the entire cost of the most effective and permanent means of protection.

The principal cause of the floods in the Mississippi is heavy or prolonged rains at certain seasons of the year, a primal cause, which lies beyond the power of man to control, but which has been greatly aided in its effects by widespread deforestation about the head waters. Flood conditions vary widely in the different tributaries. The Missouri has the largest drainage basin of any of the tributaries, about 540,000 square miles, but the average rainfall over the region is small, unusually heavy and long-continued rains are less frequent, and, because of porous soils and excessive evaporation, only a small part of the rainfall passes off in surface drainage. As a result of these conditions, the Missouri supplies only about one-seventh of the total discharge of the Mississippi and is, on the whole, as regards floods, the least important of the large tributaries. The upper Mississippi, with the drainage area only a third as large as that of the Missouri, turns in about one-fifth the total volume of the main stream, while the Ohio, draining approximately 200,000 square miles, sends down a third of all the water discharged by the Mississippi. These three rivers, therefore, yield over 60 per cent. of the gross volume, the remainder being divided between the White, Arkansas, St. Francis, Yazoo and Red rivers, which join the main stream too near the mouth to be important factors in the production of severe floods.

The Ohio is, on the whole, much the worst flood offender, partly because of its normally greater volume, and partly because of the conditions existing in the region it drains. The major portion of the areas drained by the Missouri and the upper Mississippi are distinctly less rugged than the Ohio basin, and over both areas the heaviest rainfall, coming in May and June, arrives at the season when the soil can take a large percentage of it. The largest tributaries of the Ohio, on the contrary, in etching their valleys in the surface of the Allegheny plateau, have produced the steepest and most rugged parts of the whole Appalachian region. Here the heaviest rainfall comes in January, February and March. Add to these factors the frequent complications of melting snow and frozen ground, which sheds water like a house roof, a district largely deforested, and the enormous destruction by sudden rising of the Ohio is explained. It is truly fortunate that by the provisions of nature the three rivers, the Ohio, the Mississippi and the Missouri, have never been known, and probably never will be known, to be in extreme flood at the same time. Such an unhappy coincidence

of high stages, if it came about, would quite certainly mean total obliteration for everything in the lower valley.

The flood evil is in a large way the underlying cause of most of the trouble in the Mississippi. At time of flood, the erosive power of the river is increased a hundredfold, caving of the banks is often excessive, levees situated rods from the channel before the flood and apparently safe are undermined, and the narrowing of necks between bends is greatly accelerated or quickly accomplished. Much of the damage from floods must be laid to the cavings of banks, by which landing are destroyed and whole plantations are soon swept away, while through breaks in the undermined levees the raging waters sweep over the surrounding country. This spread of the flood is fostered by the fact that the river channel lies above the surrounding bottom lands. To the naked eye the region appears absolutely level, but from the river the broad plain slips away at a rate varying from four to thirteen feet per mile. Once outside its channel, therefore, the water finds a natural course down hill into every part of the back country, carrying destruction wherever it goes. Unfortunately, this character of the river cannot be altered; on the contrary, the more the river is confined between artificial levees and restricted in the area over which it is free to spread, the greater will be the devastation whenever a flood does occur, so that with the extension of the levee system the occurrence of floods becomes an increasingly serious problem. The recognition of this fact cannot be urged too strongly, for until the flood waters are under absolute control, the construction of a deep channel, no matter whether it be in the river itself or in the form of a canal along the stream, must be done in the face of constant danger of having the entire system crippled and large portions destroyed whenever overflow takes place.

Again, when the river is in flood, as it is to a certain degree every year, it is carrying along the greatest amount of sediment, much of which represents the most fertile part of the soil. The total amount so carried is almost beyond conception, but to carry it by freight train would require 500 trains for every working-day in the year, each train consisting of fifty cars with a capacity of fifty tons. Besides this tremendous quantity poured out into the Gulf every year, other incalculable masses are deposited as bars all along the course, and as the water falls to its normal level these bars are a constant menace to every form of navigation. The presence of these obstructions and their rapid shifting from day to day has always been one of the most serious handicaps to river transportation. In fact, the abandonment of navigation on the Missouri may be laid entirely to the utter inability to cope with the shifting sands. Deforestation, cultivation of the land especially, and mining operations, are vitally important in the question of soil washing, surface erosion and the amount of sediment in the streams.

The project for a deep waterway for commercial purposes, therefore, is confronted with these serious problems which must be solved before the government can afford to spend one or two hundred million dollars

in river improvement. Some system of control must be devised to ensure to water fronts and terminal facilities a reasonable degree of permanency through protection against erosion of the banks. There must be some way of checking disastrous floods which would in a single season, and perhaps year after year, destroy improvements costing millions of dollars —as the experience of some of the eastern canalised rivers indicates. The prevention of low-water stages is no less important, since marked variations in the water level make it difficult to establish the necessary terminal facilities. Finally, the formation of sand bars must be stopped, otherwise it means stupendous, unending and probably ineffective, dredging operations in an attempt to keep the channel open.

If the Missouri could be removed from the list of tributaries by giving it a separate mouth, the sand-bar problem would no longer exist, since that stream contributes over 60 per cent. of the total brought into the Mississippi. Reducing the load by 60 per cent. would certainly mean that the Mississippi could then keep its own channel clear. But the idea of providing a separate course for the Missouri from St. Louis to the Gulf is too daring even to be suggested. Moreover, it would remove from the immediate benefit of the deep waterways project those important communities which hope for renewed navigation on the Missouri.

If the entire lower Mississippi were given a new course free from sharp bends, as could be done readily by cutting through the successive necks, the sapping and caving of banks would cease and the distance from St. Louis to New Orleans would be lessened nearly by half. That this plan is entirely feasible is amply demonstrated by the success of the Germans in correcting and straightening the Rhine. The Rhine, if possible, presented a more difficult problem than does the Mississippi, but the German engineers recognised the fact that where sharp bends exist it is impossible to prevent entirely undermining and caving of the banks. Acting on this principle, it was decided to give the river a practically new course, less winding than the former, and in which future control is ensured. Unfortunately, this procedure applied to the Mississippi would not be an adequate remedy for the floods, nor would it effectively prevent the formation of sand-bars. It is unquestioned, however, that the flood stages would run off more rapidly and a greater amount of sand would be scoured from the channel, since in a shortened course the river would have a steeper descent and consequently a more rapid flow with increased carrying power. The corrected course undeniably has much to recommend it, aside from the mere facts of feasibility and a shorter route.

If the high-water stages of floods could be prevented and the flow of the river controlled, the practical solution of the question would be at hand, for the major part of the sediment is washed into the streams at flood time, and the excessive flood volume causes most of the caving of banks. For a good many years the federal government has been at work on the Mississippi, building levees to control or prevent floods, placing revetments along the banks to check the caving action, and operating powerful sand pumps to remove the shifting bars. It is

estimated that in the last forty years the government has spent quite $225,000,000 on the Mississippi and its more important tributaries, not a single dollar of which has gone toward permanent improvement, except in the case of the jetties at the mouth, the slack water dams on the Ohio, and the removal of rock ledges at a few points. Fifty million dollars of the total amount have gone into the construction of some 1400 miles of levees and revetments along the lower course, but before the national government undertook the task of control, the states of Mississippi, Louisiana and Arkansas had already spent not less than $40,000,000 toward the same end. Much similar work has been done at one time or another by private individuals, so that, first and last, the levee-revetment system to date represents an outlay of fully $100,000,000. Yet not one cent has been devoted to the control of the excessive floods which come almost every year in some of the tributaries, simply because the levee method cannot be applied there. It must be admitted that the levee system affords fairly efficient protection from ordinary floods, in so far as damage from overflow in the lower valley is concerned, but its desirability is seriously impaired by the fact that the levees must be constantly replaced. Just as long as the river is allowed to swing against its banks the soft alluvial soil will continue to cave in; levees originally built back from the channel are eventually undermined, rendered useless, and then in cases of high water stages, unless a second line of levees exists, the entire region is open to devastation. Until the sapping action of the river is under control there can be no such thing as a system of levees built once for all. Even the most optimistic advocates of this plan do not claim more than twenty to thirty years for the life of any levee.

It is undeniable that the army engineers in charge of the work have accomplished much in saving large areas from annual inundation, but they have not to any extent permanently improved the river as a highway of commerce. Furthermore, they have signally failed in the attempts to stop erosion of the banks, for past experience shows that no style of revetment yet devised will offer more than partial or brief protection from that action. In fifteen years some landings have been forced back more than a mile, and at important points where careful revetting has been done the retreat is said to have exceeded 1000 feet. The levee-revetment system as now practised may be the simplest way of protecting agricultural interests on the river flats, but it is certainly not the most economical in the end, nor does it in any way afford even a temporary solution of the great problems confronting navigation and river commerce. The heavy expense of maintenance must go on without end until the sum total of expenditure will aggregate vastly more than the cost of the proper, permanent remedy. The most serious of all the shortcomings charged against present methods, however, is that they do not strike at the root of the evils. The place to control floods is where they originate, in the tributaries, and this would protect both tributary and main valleys; as well try to fight fires by blowing away the smoke as to control the floods by levees along the lower course. To improve the river to the extent of a fourteen-foot channel to St. Louis

would be a foolish waste of money as long as the levee-revetment system is the chief method of control.

Various other methods of control have been suggested from time to time, but most of them do not appear feasible or to offer the desired results. The rearrangement of tributaries, either by diversion or by addition, has been advocated, since the addition of tributaries to the Po very materially lessened the flood evil, the increased volume and velocity having caused a marked deepening and widening of the channel. In the Mississippi case, however, there are no important streams which could be added, and the only possible source of increased volume is by giving the Great Lakes an artificial outlet by way of the Illinois River. A certain amount of diversion or rearrangement of tributaries would be possible, though not very practicable, as by getting rid of the load of sediment from the Missouri, or by turning the Tennessee through the Big Hatchie River to reduce the Ohio floods. But in all of these radical schemes the possible benefits to be derived are far outweighed by the inevitable difficulties and disadvantages. It is unquestioned that the tributary system must remain as it is now.

The construction of artificial outlet channels to take off the excess volumes which produce floods has been suggested many times, and it seems likely that if constructed in sufficient numbers they would prove effective. There would, however, always be great difficulty in keeping the outlets so free from sand that their usefulness should remain unimpaired. A second and more serious objection to the outlet scheme is that in the lower valley, where the flood control is most difficult and the flood damage most widespread, the outlets would have to be provided by turning the water over the low-lying bottom lands. Outlet reservoirs could not be maintained because of the sand and mud with which they would be speedily filled. Under such conditions, therefore, the outlet plan clearly defeats one of the chief objects of flood control—the protection of rich plantations covering thousands of square miles on the river bottoms.

The solution by building a series of reservoirs in the head-waters of the chief tributaries appears to be the cheapest and most certain remedy for all these difficulties. By the construction of reservoirs the excess of water which produces flood stages could be impounded and held up with these important results: excessive and destructive high-water stages could not occur, while, on the other hand, by regulating the discharge from the reservoirs, a more even flow of water could be maintained at all times, eliminating to a large degree the losses from diminished water supply, reduced power and fouling of streams incident to the low stages of late summer and early autumn. As soon as the irresistible rush of flood waters is stopped the sapping and caving of banks will be reduced to a minimum, with the efficiency of revetments increased many-fold; finally, cutting down the flood volumes means a great diminution of the amount of sediment carried, and a marked alleviation of the sand-bar evil. The reservoirs would, moreover, eliminate floods from the whole system, not merely from the lower course. The prevention of the annual flood damage in the Ohio would

in itself be worth the entire cost of the reservoirs, yet until the work of control is carried to the headwaters no relief can be secured for that populous valley.

The solution by head-water reservoirs, of all proposed plans, has probably provoked the most discussion—on the one side, those who regard it as impossible, or, at least, highly impracticable; on the other side, those who consider that it is not only feasible but at once the only proper remedy. It is admitted by every one that the topography of the country about the head-waters of the Mississippi system is especially well adapted to the construction of retention dams and reservoirs. The arguments advanced against this plan, though admitting this condition of favourable topography, maintain that sufficiently large reservoirs could not be constructed and made safe or, in other words, they would, through danger of bursting, be a constant menace to the whole valley below the retaining dam. Again it is argued that if this plan were adopted, the building of reservoirs would have to be done on an enormous scale, since destructive floods often result from local conditions, such as a swollen tributary superimposed on an already swollen river. This necessity for a widely extended system of reservoirs, it is further claimed, would involve such tremendous expense as to make the adoption of the plan impossible. Most of these supposed objections are still based on a report made to Congress nearly fifty years ago, and, whether good or bad arguments then, there is no question that they do not apply now.

It is flying in the face of cold facts to contend any longer that reservoirs to retain the flood waters cannot be built, or not without danger to the entire valley below. The Ohio floods of 1907, the most disastrous for more than two decades, were due to an excess of water estimated at 23,000,000,000 cubic feet. To hold every drop of that excess discharge would have required a reservoir only a little more than half as big as the Pathfinder irrigation storage reservoir on the North Platte River in Wyoming, or one-third of the size of the reservoir in the Salt River project in Arizona. The Engle dam on the Rio Grande, a hundred miles north of El Paso, Texas, will impound about 120,000,000,000 cubic feet of water, equal to one-sixtieth of the total annual discharge of the entire Mississippi system, or more than five times the quantity of water causing the most destructive Ohio flood in a score of years. These reservoirs are being built by the government at a cost of about $4,000,000 for the Pathfinder dam, $5,300,000 for the Salt River project, and $7,200,000 for the Rio Grande reservoir. Furthermore, it is expressly stated by the Reclamation Service that the Wyoming reservoir and the Engle dam will absolutely control the worst floods which the North Platte and the Rio Grande have ever known, the latter of these streams having been a notorious offender in flood damage. The mere fact of being able to retain the flood waters in impounding reservoirs can no longer be denied, nor can the claim of danger from breaking dams be now advanced as a valid argument against this system. This government is most assuredly not spending millions in reclamation projects and encouraging thousands of people to take

up irrigated lands if there is any remote likelihood of having homes, property and lives wiped out in floods from bursting reservoirs.

Granting, then, that the reservoirs are feasible, there still remains the question of expense in constructing the number necessary to place one or more in each of the most important tributaries. Estimate the expense most generously, letting each one cost a third more than the Engle dam above El Paso, and the total figure then is less than what has already been spent on the Mississippi system. But there is another important factor to be considered—the tremendous possibilities which lie in the development of water power from each reservoir. The question of future motive power for industrial purposes, as the coal supply decreases, is a problem which must soon be met in this country, and probably will be solved by the use of water power either directly or through electricity. In fact, even now, water rights are being rapidly acquired and developed on every hand, as the advance-guard of the change that is to come. A sample of what a storage reservoir will do can be seen in the case of the comparatively small irrigation project at Minidoka, Idaho, which will develop about 30,000 horse power per year. Renting this power at the very low figure of $10 per horse power per year would pay for the entire Minidoka project, reservoir, irrigation-canals, gates and all, in six years. The amount of power generated by the Mississippi system is variously estimated high and low, with 60,000,000 horse power per year as an intermediate figure. Much of this amount is not directly available, but granting on a conservative basis that a series of impounding reservoirs would develop immediately 2 per cent. of that amount, there would be 1,200,000 horse power to be turned into electricity and distributed to factories. A purely nominal rental would be ample enough to repay in two or three decades the entire original expense of the system, and to yield a good income on the investment. The reservoir system, however, must be intimately associated with forest conservation as a vital factor in regulating surface drainage and in checking the amount of soil erosion which supplies sediment to the river.

The proper building of reservoirs in the headwaters, therefore, offers what no other plan can possibly offer: it promises effective regulation of river stages and water supply for all time to come, removes entirely the liability of destructive floods, checks the erosion of banks and prevents much of the formation and shifting of sand bars and the pollution of water which the presence of sediment means. At the same time it provides a way of actually paying for itself in a short time, aside from all idea of the savings to shippers and river interests in general which would be in excess of the cost. The importance of this latter consideration is emphasised best by a brief comparison with the system now being followed. The levee-revetment system, as mapped out, calls for an expenditure of $60,000,000 for its completion. From the engineers themselves comes the statement that the average life of a levee is not over twenty years, which means this and no more: in two score years at the most liberal estimate, the present system, completed, will have disappeared entirely and a new series of levees constructed at the cost of

another $60,000,000 will have taken its place, with conditions then no better than they are now. Considered solely on their own merits from the standpoint of control afforded, the present system has nothing, and the reservoir plan has everything, to recommend it.

In order to bring the river route to its highest possible degree of efficiency, it would be necessary to combine the reservoir system with a straightened course for the lower river, by which combination every evil would be removed and absolute control for all time would be ensured. The reservoirs would make it possible to regulate the flow of the streams, preventing both floods and very low water, and at the same time, through developed horse power, pay for the improvements. The corrected or straightened course would shorten the route and effectively put an end to caving of the banks with all the difficulties arising from it at present. The reservoirs, together with the necessary forest conservation and corrected course, would remove the sand-bar problem—the one greatly lessening the actual amount of sand carried into the river, the other giving the current increased power to sweep its own channel clean.

It is undeniable that this plan calls for a large expenditure for its completion, but in the long-run so does the levee-revetment system, without anything tangible to show for the outlay in the end. The whole question narrows itself down to a single issue: whether it is not better policy to do the right thing at the start, even if it require great initial outlay, rather than follow a plan which means the reconstruction of part of the so-called improvements every decade for centuries, with the region concerned always chafing under the handicap of a mediocre, inadequate waterway and suffering heavy annual losses from uncontrollable floods. The waste of money on levees and revetments ought to cease once for all. Let the federal government authorise the completion of the entire reservoir system with a straightened course for the lower river, and loose the bonds which every year are drawn tighter over this heart of our nation.

A TRIP TO WESTERN AMERICA.[1]

By F. R. S. Balfour.

(With Illustrations.)

My wife and I have recently made a trip to the Pacific coast, and perhaps our chief object in so doing was to see the trees of that region, the richest belt of coniferous timber in the world.

We sailed in July to Quebec, and crossed the continent by the C.P.R. We stayed for a few days at the Lake Louise Hotel at Laggan in the Rockies, about 6000 feet above sea-level, and 960 miles west of Winnipeg. The hotel lies at the north end of Lake Louise, six miles

[1] See also *Transactions of the Royal Scottish Arboricultural Society*, xxi. (1908).

from the railway, and 1000 feet above it. Soon after leaving Calgary, the youngest and one of the most prosperous towns on the continent, the train begins to wind its way up the Bow River, with the towering Rockies to the north and south. The first tree we have seen for over a thousand miles is the ubiquitous *Pinus contorta*, springing up thick and straight in all directions. No tree in America covers such an area—from Alaska to Colorado. It is well called the lodge pole pine by the Indians.

It was a mild rainy day when we arrived, and after reaching the hotel it did not take me many minutes to recognise, with my glasses, the light green of the Lyall larch, growing at timber-level — 7000 to 8000 feet. I started through the thick undergrowth of azalea and blaeberry, and was soon thoroughly drenched. The *Pinus contorta* had been left behind before Lake Louise was reached, and the timber here is *Picea Engelmanni* and *Abies lasiocarpa* solely. Both were covered with cones—even trees only six feet high—and indeed the two are much alike, but for the red drooping cones of the *Picea* and the black erect ones of the *Abies*. After a good deal stiffer climb than I expected, I reached the first of the *Larix Lyallii*, and managed to get some photographs taken while the rain was falling. The tree was first discovered by David Lyall, a Scotsman who accompanied the expedition which settled the International Boundary in 1857. It never exceeds 85 feet in height, and 2 to 3 feet in diameter. The woolly tomentum which covers the twigs and buds makes it easily recognisable. As far as I am aware, it has never before been brought to this country, but I arranged with a Chinaman to get me later on a supply of the seed and about a dozen plants which I have growing at Dawyck. The seeds ripen and are shed in the first three weeks of September; they do not remain in the cones as with our larch. I hope I may raise some plants and keep those I have got. This larch is so purely Alpine in its habit, that I have no expectation that it would ever be a useful tree in this country. Its great kinsman, *Larix occidentalis*, however, is perhaps better worth growing as a timber-tree in Great Britain than any other exotic. This tree, which unfortunately did not seed last season, does not grow so high up or extend so far north as *Lyallii*, and covers a much wider area

Lake Louise, with *Larix Lyallii* growing at timber line.

throughout Eastern Oregon and Washington, parts of Montana and Idaho, and the Kootenay County of British Columbia. A splendid tree, it often grows to 200 feet high; the largest specimen I know of is 24 feet round, 6 feet from the ground, and occurs in the Wallowa Mountains of Oregon. This is incomparably the grandest variety of larch in the world. Throughout this country there is a thick undergrowth of azalea covered with lemon-coloured blossom, not the azalea of the West, but one with small, waxy bell-like flowers. We made an expedition on horseback to the glacier which discharges into the south end of the lake, and also to two small lakes a thousand feet higher up than the hotel, where we left the timber-line behind, and found Lyall's larch growing pure. The trees of this region have their branches very short from base to top, owing to the immense weight of snow and ice which covers them for so much of the year.

I shall say little of our journey from the Rockies, across the Selkirks and Coast Mountains, to the Fraser River Cañon. Suffice to say that four miles west of Laggan the line crosses the continental divide through the Kicking-horse Pass, and almost at once the timber begins to grow western in its character. Douglas fir and *Thuja gigantea* were seen for the first time as we dropped down into the valley of the Upper Columbia River. Then when we crossed the river and began to climb up the precipitous Beaver Cañon of the Selkirks, we saw splendid *Tsuga Albertiana*, *Pinus monticola*, *Picea Engelmanni* and *Pinus contorta* which gave way gradually to the Thujas and to Douglas fir. The day's run from Laggan to Revelstoke is through as splendid mountain scenery as exists anywhere.

In the lower Fraser River valley grows that finest of all birches—*Betula occidentalis*,—a tree practically unknown here, though there is no reason why it should not thrive in our climate, so like its own of British Columbia.

Our objective point was Tacoma, in the State of Washington, on Puget Sound. In the valleys of Northern Washington through which our line—the Northern Pacific—ran, we saw Douglas and *Thuja gigantea* growing as only they *do* grow on the mild sea-board of the North Pacific. Terrible burnt areas too we passed, where not a seedling was to be seen, and only bracken and willow-herb springing up among the blackened stumps. Happily this destruction by fire has been reduced about eighty-five per cent. during the past season, owing to the excellent arrangements, regulations, and active supervision of the officers of the United States Timber Reservations. We saw large specimens of the greatest of American maples (*Acer macrophyllum*) growing among the tangles of the vine maple (*Acer circinnatum*) in all the river bottoms. Here and there was an occasional *Picea Menziesii*—it never occurs over thirty miles from the sea, and we were now well within that distance of Puget Sound.

The luxuriance of all this western timber, its size, the freedom with which it seeds itself, and its rapidity of growth, render these forests quite unlike anything to be seen east of the Coast Mountains. It is the land, too, of flowering and berried shrubs, *Spirea*, *Berberris* of several

kinds (including our well-known *B. aquifolium*), *Ribes*, numerous *Rubus*, *Gaultheria shalon*, sometimes a tree 20 feet high—the Sal-lal of the Indians,—that most striking of arbuti, the Madrona tree, the lovely western dogwood (*Cornus nuttallii*), two beautiful elders, one red and one blue-berried (*Sambucus aborescens* and *S. glauca*), several *Rhamnus*, and five great blaeberries or *Vaccinium*, some red and some blue-berried, but all, as a rule, 6 feet high.

There is a range of mountains still almost entirely unexplored, occupying the triangle of land which forms the portion of the State of Washington that overlaps the south end of Vancouver Island. A couple of days after reaching Tacoma, we set out for these Olympic Mountains, crossing Puget Sound, and driving for two days over nearly impossible roads through as fine Douglas and *Albertiana* forest as I have ever seen. The summer climate of those parts is quite delightful, never too warm, with cloudless skies and only occasional showery days. Our first resting-place was the little log hotel on Lake Cushman, surrounded by Douglas fir and *Thuja gigantea*. Seven years ago I made a small expedition after black bears across the mountains at the head of this lake, and then found at snow-level whole gardens of lovely flowers, *Fritillaria*, *Brodiæa*, *Calochortus*, orchids, and, most charming of all, the beautiful *Calypso borealis*, but that was in June. The river which feeds the lake, for a couple of miles of its course, flows through alluvial land well sheltered by the surrounding mountains from the winds of the Pacific, and here we found a grove of extraordinarily tall *Acer macrophyllum*, intermingled with *Populus tricocarpa*, *Alnus Oregona*, and *Thuja gigantea*. Their branches are thickly clothed with dense growth of yellow moss and ferns: the height of the trees I judged to be rather over 150 feet. The poplar of this region commonly grows to nearly 200 feet, and is the largest deciduous tree west of the Rockies—or, I believe, on the continent—and this great maple is second to it. I here, too, saw the largest *Thuja gigantea* I ever came across; it measured just 40 feet round, breast high, and was about 300 feet high. This is, however, by no means the record. Throughout the valleys of this range the Douglas fir must average about 250 feet, and the *Tsuga* little short of it. I stepped some trees, and found they measured 210 feet before the first branch was reached. A guide whom I had taken with me when last in these mountains told us that a party of prospectors had cut a trail up the South Fork of the Skokomish River (the North Fork was the river flowing out of Lake Cushman, up which we had come). We determined to follow this trail for a few days' fishing and exploring. We were well repaid. The first day out, with four horses and our two men, we reached the river, and camped in a clump of aspen poplars (*Populus tremuloides*), sleeping on beds of *Thuja gigantea* boughs. Most of our day's march was through dense *Albertiana* spruce, and we noticed how wonderfully this tree seeds itself, more especially on the soft bark of a rotten fallen tree trunk. Attempts at photographing it, however, were not very successful. We found *Pinus monticola* growing on the ridge between the North Fork and the South Fork. Next day we continued our way, and made our camp for three days on a little plateau in

a bend of the river in a grove of *Abies grandis*, our tent shaded by the branches of *Rhamnus purshiana*—the tree from which the cascara sagrada bark is got. It was covered with ripe black fruit, of which I dried a portion, and am sowing it in the hope of establishing the tree here. The Rainbow trout fishing was too excellent to be neglected, even for trees, as I think you will agree when I tell you that in my last four hours' fishing on that stream I caught 53 trout, weighing just 60 lbs. My wife landed a 4½ pounder off her second cast. To picture this country, you must realise that the whole land is dense forest, with open spaces nowhere except where the peaks of the hills struggle through in rocky pinnacles. Our trail was for the most part along the river-bed, which we crossed and re-crossed countless times. As in all the densely wooded regions of the North-West, one sees few birds and beasts. An occasional black-tailed deer, a still more occasional black bear, and a frequent mink in the river bottoms, were all we saw. Of birds there were a few small warblers, several woodpeckers, and a beautiful great grey kingfisher, this last to be seen everywhere.

We returned to Tacoma, and my next expedition was to the Nisqually Glacier, which flows down the south-west side of the great Mount Tacoma—15,000 feet. The United States Government have made a national park of 3,000,000 acres, with this splendid cone in the middle, and no better or wiser thing has the American administration ever done than to establish the great timber reserves—and also the five National Parks, in the most interesting localities: these are the "Yellowstone" of Wyoming, the "Yosemite" and "Sequoia Forest" of California, the Grand Cañon of Arizona, and this "Rainier National Park" of Washington, to be inviolate for all time. I may here digress for a moment to say a little on this subject. Until recently, the timber, in the West at any rate, was regarded as quite inexhaustible, and only in the last few years have the people awakened to the fact that unless a great part of the remaining forests were preserved, there would soon be no more. The total lumber cut in the United States in 1906 was about forty billion feet, board measurement. It is estimated that the West has about sixty years of timber for itself—over 70 per cent. of which is "Oregon pine," or rather Douglas—but the East, whose own supply will probably last for not more than twenty years, is drawing on the West for prodigious quantities of sawn timber. Washington is now the State which supplies the greatest amount of timber of any. From 1870 to 1890 Wisconsin, with its white pine (*P. strobus*), had the predominance, then Louisiana, where *Pinus palustris* is cut in enormous quantities

Mount Hood, 12,000 ft., Oregon, from Lone Lake.

(the Americans call it "yellow pine" and we call it "pitch pine"), but now Douglas fir provides more lumber than any other tree on the continent. The United States Government Timber Reserves now amount to 126,000,000 of acres, by far the larger part of which is in the West. These are being well looked after when we consider the magnitude of the task, the supineness of the State legislatures, the opposition of the lumber magnates, and the fact that the whole organisation has only recently been started.

A little light railway through the Douglas and Thuja takes one to within a few miles of the boundary of the Mount Tacoma Government Reserve, and a drive of a dozen miles or more of steep climbing brings one to the hotel recently built at Longmires Springs. The Government carriage road is completed to a little beyond this point, but the intention is that it shall be continued to Paradise Valley—9000 feet above the sea—which is at timber-line. The spot is well named, as, perhaps, there is no finer Alpine garden in the world than this huge belt immediately above the trees, and below the eternal ice of the mighty cone of Mount Tacoma. The trees here are very fine, Thuja, Douglas fir, and *Tsuga Albertiana*, *Abies grandis* in the river-bed, and an occasional Menzies' spruce, till the eastern limit of this tree was passed. Then *Abies amabilis*, *Pinus monticola*, *P. Murrayana*, and at Longmires *Abies lasiocarpa*, *Tsuga Pattoniana*, and *Chamæcyparis nootkatensis*. I never before saw this last-named tree, and feel sure it is worthy of general planting in our country as a forest-tree. It covers a wide area from Alaska to Washington. The specimens in this country have mostly been raised from cuttings, and I believe it would be desirable to get large supplies of seed from its native place. Its wood is practically imperishable, but is no use for shingles, as it cannot be split like Thuja or Libocedrus. I went on to the Nisqually glacier, to which the Government road has just reached. The difficulties of blasting out stumps and rocks for such a road may be imagined. I found here the charming little *Acer glabrum*, which only grows at high altitudes in the western country. I know of no other valley in Western America where such a variety of conifers may be seen growing together, and all at their best —two hemlocks, four Abies, two pines, one Picea, one Thuja, one cypress, the omnipresent Douglas—twelve altogether.

We next travelled south to Grant's Pass in South-West Oregon. Unfortunately our day in Portland was cloudy, and no view was had of Mount Hood (see p. 481), the great rival of Mounts Tacoma and Shasta. The Siskiyou Mountains, which run east and west more or less, divide Oregon and California, and this is the home of that rarest of all spruces, *Picea Breweriana*. The character of the soil is greatly changed here from that of the north. The ground is dry, and there is not the great depth of rich humus in all the valleys which one sees in Washington. We drove thirty miles to the old mining settlement of Kerby, and next day started over an abominable road to find our spruce. A friendly placer-miner acted as guide, and after a climb of 4000 feet through almost impenetrable and what seemed interminable thickets, we found our tree just at timber-line, growing singly among Douglas fir, *Pinus*

ponderosa, and *Pinus tuberculata* (the knob-cone pine). It is a beautiful tree, utterly distinct in character, with drooping branchlets often eight feet long. The tops of the trees were covered with cones a good month from being ripe. It was first discovered in 1884, and named after an eminent Californian botanist. Its cones, when the seed is shed, reflex their scales, and are of a rich brown. The unripe cones are purple, about 2½ inches long. I imagine the wood of the tree is extremely hard, growing as it does at a fairly high altitude, and evidently making small annual growth. The bark is grey, and in flakes not unlike that of our larch. The trees of this district are very different from what we had left: *Pinus ponderosa* and *Pinus Lambertiana*—those two kings among pine trees—predominated. *Thuja gigantea* had given way to *Libocedrus decurrens*, and in the valleys grew the *Umbellularia Californica* —a mighty bay which occasionally reaches 100 feet; the *Castanopsis chrysophyllum*, with its shining leaves, bright yellow underneath, and chestnut-like fruit; and the *Pasania*, or tan-bark oak. The *Fraxinus Oregona* I saw here finer than elsewhere; it is an ash which I hope may succeed admirably in our own country, judging by the fine young tree at Kew. It is the most valuable hardwood in the west. I have distributed the seed of this tree to sixteen or more localities in Great Britain. I saw the *Chamæcyparis Lawsoniana* that day—3rd September —for the first time; but to see this splendid tree at its best we ought to have gone west a farther fifty miles to the coast. No tree in Western America is more prized than this "Port Orford Cedar," as the lumbermen call it. Its wood is almost imperishable, and its delicious scent makes it highly suitable for interior finishing, etc.

A stranger in the country has a little difficulty in identifying trees by their local names. For instance, I was told I ought to see the "larch" on Mount Tacoma. This I found was *Abies nobilis*. "Red cedar" in British Columbia and Washington means *Thuja gigantea*: "red cedar" in South Oregon and California means *Libocedrus decurrens*. "White cedar" in Washington means *Cupressus nootkatensis*; "white cedar" in Oregon means *Cupressus Lawsoniana*. But, worst of all, the name "Tamarack" is applied in different neighbourhoods to *Larix occidentalis*, *Pinus tuberculata* and *Pinus Murrayana*. This confusion of nomenclature also extends in America to the birds and beasts.

We made a four days' camping expedition from Kerby southwards to the main ridge of the mountains, crossing the Californian boundary. It is a beautiful countryside. There are several fine oak trees—*Quercus densiflora* or *pasania*, mentioned above, *Quercus Wizlizeni*, and *Quercus Garryana*—said to grow to 150 feet high, and nearly a dozen species of willow; quantities of gentians occur in the marshy spots, with the yellow pitcher plant (*Darlingtonia Californica*). We found groves of the *Prunus demissa* with the fruit ripe and hanging in bunches—a charming tree. The hill-sides are clothed with *Manzanita* and *Ceanothus* bushes. Our guide was anxious to take us to what he believed to be the "weeping spruce" we were in search of; but after a hard day's toil up steep hills, over trails which none but a backwoodsman could differentiate from the surrounding brush, we found ourselves among a number of Douglas fir,

whose branches, growing in a curious bunchy form, had misled our man. However, the scenery well repaid the extra labour. That night we camped close to the divide, and next day, while hunting the hill-tops for black-tail deer, I came quite unexpectedly on a splendid grove of *Picea Breweriana* in a corry facing north. I took numerous photographs of the trees; they were growing among *Abies concolor*, *Abies magnifica*, Libocedrus, and Douglas. I saw no cones on these trees. They stood distinct and beautiful, with their long fronds often hanging 8 feet to the ground. On this ridge the Libocedrus and Douglas were gnarled and twisted by the wind into the most fantastic shapes. We returned to Kerby and Grant's Pass highly satisfied with our week's trip, and pleased to have found what we had gone so far in search of.

We took train from Grant's Pass, by night unfortunately, as we were limited as to time, and next morning found ourselves at Sisson, at the base of Mount Shasta in North California. Here a small branch line leaves the Southern Pacific, and proceeds due east to a timber settlement called M'Cloud, after its founder — doubtless a Skye-man. Six miles from here is the charming house of a friend of mine, on the edge of the great Shasta Timber Reserve, in a bend of the M'Cloud River. Its banks are clothed with a huge saxifrage, among which the vine maple leaves were just turning scarlet. The timber is Douglas and *Abies concolor* close beside the river; higher up *Pinus ponderosa* and *Pinus Lambertiana*, growing finer than any I have seen elsewhere in California; while still higher are *Pinus monticola* and *Abies magnifica*—the *Shastanensis* variety, which has dark bark instead of red, as in the common form; and last of all *Pinus albicaulis*, sometimes dwarfed to a tree 2 or 3 feet high, although a hundred years old. The photographs of Mount Shasta—14,400 feet—will show you how that splendid cone overlooks the whole country for at least one hundred miles in every direction. Down by the M'Cloud *Taxus brevifolia* is abundant, never such a large yew, however,

Mount Shasta, 14,400 feet, Northern California.

as our *T. baccata*, but very beautiful, with its red berries and dark branches sheltering the lovely Shasta and Humboldt lilies, which grow tall and straight in the moist glades where the sun seldom penetrates. I found here, for the first time, *Cratægus Douglasii*, the only hawthorn which grows in the western country, although 400 or 500 species are known east of the Rockies. I also saw a small mountain ash which I could not identify. The brushwood is wild plum (*Prunus subcordata*), at this time covered with fruit, much sought after by the Indians, the Californian hazel (*Corylus Californica*)—to me quite indistinguishable from our own, and, of course, the universal manzanita scrub and alder. While we rode with our host to "salt-licks," where the deer were to be found in the early mornings, we got many lovely glimpses of Mount Shasta towering above the surrounding forests. We scrambled up banks of incredibly slippery pine needles to gather the huge cones of the sugar pines, many of them 20 inches long: these we brought home in sacks tied to our Mexican saddles. Our host every year has new trails cut through the brush, and this summer came on two enormous specimens of sugar pine and yellow pine. My photograph of the latter was a failure, but it shows to what a gigantic size *Pinus Lambertiana* sometimes grows. The summer climate of this Northern California country is wellnigh perfect, six months of unbroken sunshine.

THE PRIMITIVE RACES OF SOUTH-EASTERN ASIA.

In the *Revue Générale des Sciences* for April 30, there appears a very instructive article on the primitive types of humanity to be found in South-Eastern Asia, the article being by Dr. Fritz Sarasin, known, together with his cousin M. Paul Sarasin, for his explorations in Celebes. As the questions dealt with are of great interest in connection with the evolution and classification of the human race, an abstract of this article may be found useful by many of our readers.

It is well known that, hidden among the forests and rocky chains of tropical Asia, there exist remnants of primitive races which hold themselves apart from the more civilised tribes surrounding them, and which seem to represent a primitive layer of humanity, whose scattered existing members are as it were living fossils, witnesses of bygone conditions. Among the representatives of this group which have been longest known are the Veddas of Ceylon, the most celebrated of all, and after them certain forest tribes in British India. Until a few years ago it was believed that this Vedda layer, as the Sarasins have named this dying group, was not represented outside of Ceylon and British India. Within this period, however, various researches have proved that the Vedda layer is still represented elsewhere. Thus Martin has shown that the Senoi, found in the forest-covered mountains of the interior of the Malay Peninsula, have certainly Vedda affinities. Again, the work of the Sarasins on Celebes showed that the Toalas, a small tribe largely enslaved by the surrounding tribes, are of Vedda

race. In Sumatra also, Hagen has discovered remnants of the same stock, and it has been further recognised at Banka, Bileton, and the Riow group. Some branches of the Dyaks of Borneo have probably Vedda affinities, and elsewhere in the islands to the east of Celebes the same stock probably exists. On the mainland of Asia similar discoveries may be expected. In Indo-China, in the northern part of the Malay Peninsula, remnants of savage tribes living among civilised races have been described, who may prove to be of Vedda origin. In short, over immense tracts of Asia and the neighbouring islands, traces of a disappearing primitive stock have been observed.

Three branches of this stock are tolerably well known at the present time. These are the Veddas of Ceylon, the Senois of Malacca, and the Toalas of Celebes, the first of which are separated from the last by forty degrees of longitude.

What characters in common do these three groups of human beings possess? In the original paper the answer is partly given by some striking photographs, but we may here, in default of illustrations, sum up the chief points. The first point is the relatively low stature as compared with the surrounding civilised races. Among the Veddas and Toalas the stature of the males is respectively 157·5 and 156 centimetres (about 62 and 61·4 inches), while the Senois are still less, being 150-155 centimetres (about 59·1 to 61·0 inches), according to the tribe. The stature is thus low, but the men are not pigmies. Further, the skin is always darker in tint than that of the surrounding tribes, and the hair is very wavy, or even curly, and where it has not been cut surrounds the head like a mane. The three tribes thus belong to the cymotrichous group of mankind. Further, in all three the hair is but slightly developed on the face, where there is a chin tuft and a small moustache, while the hairs on the body are also only slightly developed. The face is broad, flattened and angular, and narrows rapidly below, terminating in a point. This is in marked contrast to the surrounding races, whose faces are longer and form a rounded oval. Again, in the three tribes under consideration, there is frequently a bony brow ridge and a prominent glabella, with the result that the eyes appear deeply set, as does also the base of the nose. The nose has a low bridge, is often concave in profile, and has protruding wings. Very frequently a lateral fold unites the nose to the skin of the cheeks. The region of the lips is generally markedly protruding, and there is distinct alveolar prognathism—that is, the dentition is oblique, but it is remarkable that there is never more than slight prognathism of the whole jaw. The chin is generally receding.

The foot also is highly characteristic. In front it is enlarged in a fan-like fashion, the instep is only slightly arched, and the large gap between the great toe and the others, combined with the position of the great toe relative to the other four, suggest inheritance from a climbing ancestor. In the Malay region civilised Malays can readily distinguish between the tracks of the Senois and their own, although neither party ever wears shoes.

As regards the skeleton, the bones of recent Toalas have not yet

been obtained, but ancient bones of that race show remarkable resemblances to those of Veddas and of the Senois, which again resemble one another. Without going into anatomical details, it may be sufficient to signalise here as the important points the small size of the cranial cavity, the large orbits, often with a bony brow ridge, the narrow interval between the eyes, the concavity of the lumbar region, a large gap between radius and ulna, a relatively long forearm in relation to the arm, and so on. Very striking also is the delicacy and almost elegance of the bones, the muscular attachments being feebly developed. As to form of skull there is much variation. The Veddas are dolichocephalic, or rarely mesocephalic; the Senois are generally mesocephalic, and the Toalas occupy the border-land between the brachycephalic and mesocephalic conditions. These differences are, however, easily explicable in view of the separation in space of the groups at the present day, and the occurrence of intercrossing with the peoples among whom they are now respectively found.

Apart altogether, however, from these anatomical resemblances, the three groups show striking relations in their methods of thought and habits of life; what Dr. Sarasin calls their ergology. The existing representatives, living among alien races, and victims of the struggle for existence, have naturally had their mode of life greatly modified. It is nevertheless possible, in the case of the Veddas and Senois, to sum up as follows what must have been the primitive conditions of life. Those still untouched by civilisation are nomad hunters, without agriculture and without domestic animals except the dog, living in caves or under rocks, and erecting little shelters in the open air to pass the night, or even often sleeping without protection. Clothing consists of a cord round the body suspending an apron made of bark or of trade goods, or sometimes of leaves or branches. The Veddas despise all personal adornment, but this is not the case with the Senois. The food consists of the products of the chase obtained by bow and arrow, or in the case of the Senois by the blowpipe, and of honey, leaves, bark, fruit, and roots obtained in the forest. The tribes have no knowledge of metallurgy, no pottery, no power of weaving stuffs nor making nets, no means of navigation. Everything found in their possession in the way of iron vessels, arrow heads, iron knives or hatchets, has been obtained by barter from their civilised neighbours. The organisation is patriarchal, but there is no titular chief. The oldest or wisest of the group forms the natural head. Each little group has its own fixed hunting preserves, marked by streams or rocks, and as a general rule these limits are respected by other groups. Marriage is monogamous, and is supported by a strong sentiment of jealousy. Theft, lying, and war are unknown. Needs reduced to a minimum; modesty, benignity, gratitude, and a strong sense of dignity are the chief moral peculiarities. In their relation to the surrounding civilised tribes these races often show some haughtiness, which is perhaps in part due to the fact that they are commonly regarded as supernatural beings by these tribes. Above all, they show a marked fear of strangers, which has given rise in the groups which indulge in barter to the strange habit of secret exchange. The

forest tribes lay at a fixed spot the products which they wish to exchange, and the other party removes these and leaves trade goods in their place, without any personal contact between the traders.

In the beginning there were no funeral ceremonies. A dead body was left on the spot where death took place, this being abandoned by the living. At the most the corpse might be covered by leaves. At the present day this primitive condition rarely persists. Religious beliefs are minimal, and where present seem to be due to the influence of a higher race. Knowledge is apparently very limited. In several cases the Sarasins have met Veddas who could not count above one, and expressed plurality by repetition—one, one, one. A Vedda language is no longer discernible, having been replaced by Sinhalese, just as the Senoi language is being replaced by Malay. The Toalas of Celebes, who are under the control of a Mussulman master or *guru*, have lost many of their primitive characters, but still retain enough to suggest strong ergological affinity with the Veddas and Senois. Thus, although they now cultivate maize and rice, yet the caves show that formerly there were no cultivated plants, not even the cocoa-nut palm. They now possess as domestic animals fowls as well as dogs, but the investigation of the caves shows that formerly the dog only was kept. The dead are now buried by the *guru*, but the caves show that formerly the dead bodies were simply abandoned.

Comparing these forest Vedda tribes with the Australians and the Dravidians of India, Dr. Sarasin believes that there is evidence to justify the belief that both the latter have diverged from a primitive Vedda type. But it is to be remarked that in south-eastern Asia, as well as the primitive Vedda tribes with their wavy hair, there is also a stock with woolly hair (ulotrichous). If, however, it is true that the presumed continuous Vedda group has been split up into divergent and widely separated sections, this is much more true of the ulotrichous group. Between the small woolly-haired inhabitants of the Andaman Islands and the Semang of the Malay Peninsula there are signs of close affinity, in spite of the ten degrees of longitude which separate them. Twenty or more degrees separate the Semang from the Negritos of the Philippines. The statement that a similar woolly-haired race exists in Celebes, though the assertion is often made, is certainly an error. No trace of such tribes were at least found by the Sarasins. To find other representatives of the woolly-haired tribes a hundred degrees of longitude have to be crossed, when the pigmy Africans are encountered. The affinities of these tribes, and also of the equally woolly-haired Papuans and extinct Tasmanians, does not, however, come into the scope of the present paper. The author confines himself to the statement that an examination similar to that made in the case of the Vedda groups, would show close affinities both in structure and in mode of life between the Negritos, Semangs, and Andamanese.

It appears then from the above that the primitive Negrito and Vedda races are distributed over vast extents of the earth's surface. From this it necessarily follows that these peoples are of very high antiquity. Further, when it is considered that they are either not

navigators at all, or like the Andamanese only to a very slight extent, it is obvious that their extension over the surface can only have taken place when the form of the earth differed notably from its present conditions in the regions concerned. For example, the Andamanese could never have reached their present position unless the Andaman Islands were formerly connected to the continent by a land bridge. The former work of the Sarasins on the fauna of the Celebes led them to believe that in the Pliocene period, and until an advanced period of the Pleistocene, a complete system of land connections existed in the Indo-Australian region. Java, Sumatra, Borneo, were for a long period in connection with the Indo-Chinese continent. From the north of Borneo extended two bridges, one passing by the existing Palawan island, the other by the archipelago of Sulu as far as the Philippines. Java was connected to the south of Celebes, and furnished it with a large series of characteristic animals. In the same way the north of Celebes was prolonged by the island groups of Sangir and Talaut as far as Mindanao, the most southern of the Philippines. Further, Celebes extended its eastern arm as far as the Moluccas, which in their turn were connected with New Guinea, which must certainly have been temporarily united to Australia. It does not matter for the present purpose whether these land connections all existed at the same time, or whether they were successive; it is sufficient that they did all exist, and that by means of them the Veddas and Negritos were distributed over lands now separated by the ocean, and that it was thus that man, accompanied by the dingo, was enabled to reach distant Australia.

A careful examination of the Negrito and Vedda types shows that the distinctions between the two are much less marked than might be supposed at first sight. Many anatomical resemblances exist, leading to the belief that the main difference is in the character of the hair, which again leads to the belief that the two must be regarded as having a common root, and are to be regarded as primary varieties of the human race. Though no existing forms can be regarded as representing the characters of these primary varieties in their purity, yet the deviations from the type are so small as to raise the question how so many primitive features can have been retained with so little variation for almost countless ages. These groups at least show a remarkable conservatism, which is only partially explained by the isolated and sheltered life in the forests, which has prevented intercrossing, and has been unfavourable to rapid variation.

Still one other problem, however, remains. What is the relation of these primary human varieties to the still more primitive incipiently human types? Two rival theories as to the origin of man from lower forms are in the field. On the one hand, Schwalbe derives him from an anthropoid, through *Pithecanthropos erectus* of Java and *Homo primigenius*, represented by the Spy and Neanderthal skulls. Along this line the distinguishing features of the early ancestors are, as regards the skull, the low forehead, the slightly developed brain-case, the enormous development of the brow ridges, the absence of a chin, teeth with numerous folds of enamel, and so on. If this theory holds, then such relatively

delicately constructed races as the Veddas and Negritos cannot be on the direct line of evolution, and they are indeed regarded by Schwalbe as mere local varieties comparable to dwarf races among animals.

On the other hand, Kollman lays great stress upon the significance of these races, with their delicate, non-brutish skulls, and emphasising the rounded brain-case and other cranial characters of the human infant, seeks the ancestor of man in a Tertiary Anthropoid with a delicately formed, rounded, brain-case and a low stature. For Kollman, therefore, Pithecanthropos, no less than Neanderthal man and the living Anthropoids, represent side-branches, from which no higher forms have evolved.

The Sarasins take a somewhat intermediate position between these two extremes. They believe that *Homo sapiens* arose from a type of *Homo primigenius*, but not from the type with strongly ossified skeleton found so far only in Europe, which they regard as a side-branch. The real ancestor was, they believe, a more delicately built tropical form, from which the primary varieties named above rose. These, therefore, they consider to be "the most primitive and the most ancient forms of *Homo sapiens* still living at the present time." The remainder of the paper is devoted to a vigorous refutation of the theory that the Veddas and allied races are degenerate. The author is of opinion that their mode of life, the evidence of history, and the evidence of prehistoric implements, etc., are all opposed to the view that these interesting peoples are degenerate, and support the contrary view that they are primitive.

ERRATUM.—In Prof. Gregory's paper in the July *Magazine*, p. 362, line 14 from top, *eastern* shore should read *western* shore, and an *if* has been omitted from line 4 on p. 360.

GEOGRAPHICAL NOTES.

EUROPE.

The Peninsula of Istria.—Dr. Norbert Krebs has recently published a comprehensive monograph on this peninsula (*Die Halbinsel Istrien*, *Geographischen Abhandlungen*, ix. 1907), in which he treats of the geology, morphology, hydrography, shore lines, climate, vegetation and people of the area. The region is important, as is well known, because of the development of Karst phenomena, which make it at once interesting to the geographer and geologist, and economically poor and scantily peopled. The climate and the vegetation are interesting in that both show a transition between the Mediterranean and the Pontic conditions. As regards rock structure, limestone of course predominates, and produces a characteristic type of scenery and vegetation, while about one quarter of the area is covered by sandstone and marl. The limestone shows a characteristic bare, deeply eroded, sterile surface, water being scanty, while the sandstone and marl areas have softer outlines, are well watered, and the rocks in places weather to form good soil.

In regard to the vegetation especially, many interesting points emerge from Dr. Krebs' study. Round the coast, especially between Rovigno and Pola, and on the islands of Brioni and Lussin, a typical Mediterranean "maquis" occurs wherever the maritime climate reigns. It only occurs on calcareous soil, and the constituent plants are evergreens, which are often furnished with spines, and do not exceed 1 to 3 metres in height. On passing inland to the sub-littoral zone this thicket is replaced by a type of evergreen heath, consisting of evergreen plants averaging half a metre in height. The plants are species of Erica, rosemary, thyme, and especially *Helichrysum italicum*. This association is especially developed on the shores of the Quarnero, to the east of Pola, and is rarer on the western coast. On travelling further inland the number of deciduous plants gradually increases, causing the evergreen heath to become the typical Karst-heath. The upward limit of the evergreen heath is about 150 to 200 metres. The Karst plateau, which has a climate like that of Hungary, with hot summers and cold winters, together with part of the Flysch, was formerly completely covered by deciduous forest. In places this forest has given place to cultivated land, while in some other localities it has given place to the poor Karst-heath or to pastures. In the forest the trees are of no great height and are scattered; undergrowth is wanting and there is not much humus. Up to a height of 600 and even of 800 metres various species of oak predominate, but mingled with the predominant oaks species of hornbeam, maple, elm, alder, etc., occur. The Karst-heath, as already stated, replaces former forests. It is especially characteristic of the Plateau of the Tschitschen Boden, of the Karst of Trieste, of the east of the Istrian plateau, and of the western and southern slopes of Monte Maggiore. It is absent only from the uppermost and lowest regions, forming a band between 300 and 800 metres in width. The vegetation is very uniform. In the sunny areas occur a few shrubby plants, such as the evergreen asparagus and deciduous but spiny species of Rubus, Rosa, and Paliurus, but the characteristic plants are Labiates, notably thyme, ground ivy, sage, etc., and Composites, notably thistles, mingled with juniper, spurges, and in the dolines with wild cherry and sloe. Here and there one finds a large oak as a testimony to the former existence of forest. The dolines, which are surrounded by walls to protect the flocks, form oases, in which grow plants and trees unrepresented elsewhere.

On the mountain one finds, beginning at 600 to 700 metres, pasturages where the plants of the Alpine flora mingle with those of southern Europe. These pastures form clearings in the forest. At the upper limit of the oaks hazel becomes frequent. Beech makes its appearance at 700 metres and does not disappear till 1700 metres. It occupies all the high summits, and with birch, maple, alder, elm, forms a very dense forest. Conifers are rare. As regards cultivated trees, the olive thrives well on the limestone and ascends to 350 metres. The vine and fig ascend to 400 to 500 metres, while between 300 and 500 metres the chestnut is extensively cultivated. The villages of the Karst are always surrounded with walnut trees, and in lower Istria the village affairs are discussed beneath the shade of an antique nettle tree (Celtis) planted in

the centre of the village. The authorities are now making great efforts to promote afforestation over the deforested area.

Africa.

The Forest of the Ivory Coast.—In *La Géographie* for March 15, M. Aug. Chevalier gives an interesting account of the virgin forest which forms a coastal belt along the Ivory Coast, and is continued into the Gold Coast and Liberia on either side. Much of this forest is still unexplored, and progress through it is excessively difficult. Here man is completely subordinated to the dominant plant life, and can move but little from his native village. The villages are connected by tracks which are very faintly marked and very difficult to traverse, and which differ very little from the many monkey tracks which cross them in all directions. Like the wild animals of the forests, the human inhabitants find in it everything necessary for life—food, clothing, and shelter. Agriculture is reduced to its simplest form. Small quantities of bananas, manioc, taro, rice, etc., are cultivated, but the forest speedily reinvades the cleared patches, and the people have remained at a very low level of evolution. The geological composition of the area is very difficult to study, for surface erosion seems to be at a minimum, and the rocks are very rarely exposed. The study of the hydrography of the region is also excessively difficult, for the streams have no well-defined beds. Their banks are bordered with an almost impenetrable fringe of spiny climbing palms, and at the rainy season they inundate all the surrounding low-lying country. In the dry season, again, the streams may be so completely dried up that their position is difficult to trace; the courses of the minor streams are indeed often very vague, the water in the rainy season meandering through the forest. The whole condition described by M. Chevalier is extraordinarily interesting as showing at its maximum the protective nature of the forest in relation to the forces of erosion.

The limits of the forest are well marked, and it proves to be less extensive than the difficulty of traversing had led previous observers to believe. In the Ivory Coast it covers about 120,000 square kilometres, and extends northwards to about 8° N. in the region of the Upper Cavally, and to about 7° 30′ N. in the basin of the Comoe, but is constricted in the centre by a deep V-shaped region, enclosed by the Bandana and its tributary the Nzi, where the Savanna region encroaches upon it. On this northern border the dense forest passes into a bush region, with numerous "gallery forests" along the course of the streams, and scattered brushwood, which gradually passes into the true savanna of the Sudan. Southwards the forest dies away at the border of the coast lagoons, or at the sea where the lagoons are absent. Near some of the shore lagoons, however, certain curious non-marshy savannas intervene, whose origin is unknown; they do not appear to have originated in the destruction of forest, and are not used for cultivation.

As to the composition of the forest, it may be said to form three tiers. The uppermost consists of the high trees, usually 30 to 35 metres in

height, which are bound together by lianes, so that a continuous vault of green is formed. Through this sea of foliage, individual trees of 40, 50, or 69 metres in height emerge to the daylight. Beneath this vault lies a second story of partially etiolated trees, of less height, while below them is a third story, consisting of shrubs and herbaceous lianes, which is so compact that the light which penetrates to the soil is excessively faint. The surface of the soil is therefore in general bare, with here and there a few small climbing plants whose violet leaves are adapted for catching the last rays of light. Dead leaves are rare, for they are attacked by termites or fungi as soon as they fall, and so destroyed. One of the surface fungi produces a phosphorescent mycelium, which in the rainy season covers all dead vegetable matter, so that at night the soil of the forest glows with a faint light. As to individual trees, palms are abundant in individuals, but not in species. The cocoa-nut palm is not indigenous, and occurs only near the villages, never in the forest; the oil palm also, although common, appears to always occur in the vicinity of cultivated ground, or as an escape. On the other hand, Raphia palms are very abundant, as are also the liane-palms like Calamus, whose spiny branches form one great obstacle to progress in the forest. The chief products of the forest are oil from the oil palm, rubber, and cabinet woods. The last are as yet insufficiently exploited and form the great hope for the future. Kola nuts also offer a valuable field for exploitation.

Sleeping Sickness in the French Congo.—The results of the French scientific mission to the Congo for the study of the sleeping sickness are recounted in the July number of the *Dépêche Coloniale Illustrée*. That mission, under the charge of Dr. Gustave Martin, did not get seriously to work before June of last year. It has had to struggle against the inertia and often the ill-will of the natives. In the region of the Upper Ubangi and the basin of the Gribingi and the Shari the mission found only isolated cases of the disease. On the other hand, in the immense country of the Middle Congo, the Sanga, and the Ubangi up to the sea there are no points where the plague has not exercised its ravages, devastating entire villages. The members of the mission have personally visited the caravan routes from Brazzaville to Loango up to Buanza, Madingu, and the mountainous region between the copper zone of Minduli and the former political post of Manganga, the Upper Alima, the Lower Sanga, part of the valley of the Congo, and the Upper Ubangi as far as Fort de Possel and Bessu.

As a general result of their observations it is evident, says the present report, that no diagnosis of the sleeping sickness is certain without the revelation of the presence in the organism of the trypanosome. The best microscopic method of discovering the presence of the microbe is a problem which has absorbed the attention of the mission. By the mere microscopic examination of the blood 258 natives were found harbouring the microbe and twenty Europeans were discovered to be infected. The director of the laboratory department of the Pasteur Institute, M. Mesnil, says, indeed, in his report on the preliminary

studies of the French mission, that minute examination of the blood of all Europeans who have spent some time in the tsetse zones is an operation that ought not to be neglected. No vaccine nor serum avails to cure the sleeping sickness. The future belongs to chemical therapeutics, and the atoxyl treatment is the only one which, according to this authority, gives generally good results.

The rôle of the tsetse fly in the transmission of African trypanosome is discussed in detail in the present memoir, which offers, however, a number of facts proving that the infection cannot be due solely to the tsetse, and suggesting that mosquitoes may be one of the chief agents. Where the purifying rays of the sun are allowed to penetrate, the chrysalis of the fly is quickly destroyed. Poverty and anæmia favour the propagation of sleeping sickness.

The French mission, aided by the Government and the geographical societies, proposes a certain number of practical preventive measures. A sum of 250,000 f. (£10,000) is now being solicited to continue the work already begun and to place France on an equality with the other Powers in the struggle against this terrible plague.

Australasia.

Volcanic Activity at Kilauea.—This volcano is now in a very active state. The journal *Science* for July 3 quotes from a Hawaian paper the following interesting account of the phenomena displayed :—

"The central pit has filled up by the rising of molten lava within its walls until its floor is now only about 200 feet below the level of the main crater. At this level, 200 feet below the spectator, there is a lake of molten lava, in the shape of the figure eight, approximately 800 feet long by 400 feet wide. Near the centre of the northern lobe of the lake is an island some 78 feet in length, in the shape of a half moon. Within the little bay formed by the points of this island there is an almost constant boiling of the molten lava, with explosive bursts of gas every minute or so, which throws masses of the molten fluid into the air some 30 to 40 feet, and scatters it over an area of approximately 100 feet in diameter. Immediately after each outburst of gas a tremendous suction draws the lava from a radius of 100 feet of the bay into a vortex like that of a maelstrom, great cakes of lava 15 or 20 feet in diameter being turned up on edge, sucked in and disappearing like chips down a whirlpool.

"Immediately north of the island, at a distance of not more than 100 feet therefrom, there is a gigantic outpouring of lava from beneath, without any bubbles or explosions. It looks like an enormous spring, the lava simply welling up and flowing off in all directions. The current is so rapid that the surface of the lake does not have time to cool, except in spots, and these spots are at frequent intervals upheaved by convulsions from beneath, and the black crust engulfed in the liquid lava beneath. The crusts striking the banks of the lake, which are from four to six feet high, are either shoved bodily upon the banks, like ice cakes in the Arctic, or upturned on edge and swallowed up in the fiery depths

below. At intervals boiling spots appear at various points on the lake; engulfing the black cakes of lava floating thereon. The outpouring of the lava from the great spring is so great that the level of the liquid lava is raised faster than the surrounding banks can retain it, and at frequent intervals the banks give way and torrents of lava flow out into the surrounding territory in the pit, until that portion of the pit is raised to a level that stems the flood.

"This action has been going on now for several weeks, the lake constantly enlarging and the floor of the pit being raised by the overflows of lava.

"The brilliancy of action can be judged from the fact that a lantern is not needed in crossing the rough floor of the crater, the light from the lake being more than sufficient to show the trail in its details. The glare of the lake can also be seen any clear night from Hilo and Honuapo, at distances of 31 and 35 miles, respectively."

Exploration of the Sub-Antarctic Islands.—We have received a newspaper report of the Annual Meeting of the South Australian Branch of the Royal Geographical Society of Australasia, which was held at Adelaide towards the end of May. At this meeting the president, Mr. W. B. Wilkinson, in summing up the chief geographical events of the year, gave some account of the recent New Zealand expedition to the Campbell and Auckland Islands. It will be remembered that Mr. Pillans, whose article on these islands appears in our July issue, was on the vessel which carried the scientific expedition. The following quotation from Mr. Wilkinson's address is therefore interesting as supplementing Mr. Pillans's paper:

"Last year New Zealand dispatched a party of some twenty scientists on an expedition to the Auckland and Campbell Islands, the chief object being to make a magnetic and geological survey of these islands. The party, under the leadership of Dr. Farr, did valuable research work, and the *New Zealand Times* states that 'a large addition has been made to our knowledge of the fauna and flora of the sub-antarctic islands, and the geology is certainly put on a new basis.' The members of the party during their investigation undertook much arduous work in conducting the magnetic and geological survey, which entailed long marches over rough country over which it was necessary for them to carry heavy instruments. Considerable portions of the islands were quite unexplored, and the travelling at times entailed considerable hardship and danger. The weather during part of the time was most unpropitious, fogs and rain considerably interfering with progress and scientific work. At times huge beds of peat up to 50 feet in depth had to be crossed, and in certain parts the land was so densely covered with scrub that 'progress could only be made by rolling right over it or occasionally crawling underneath.' The geological investigations among other things showed that the islands have been subjected to comparatively recent glaciation, and a report from a member of the staff states: 'In order to account for this glaciation it is necessary that the land should have been higher probably by several thousand feet. This would

cause the islands to be more closely connected with New Zealand, and would allow of a larger space for those plants to grow which have found a last home on the grass-covered and boggy upper slopes. It would explain why the plants and animals are so closely connected with those of New Zealand, and go a long way to solve many other biological problems.'"

Polar.

Peary's New Expedition.—We noted briefly in our last issue the fact of Commander Peary's departure on a new Polar expedition. The following detailed account of his plans, quoted from a *Times* article, is of interest. As has already been stated, the Arctic explorer will pursue the same route north as before—namely, *viâ* Sydney (Cape Breton), the Straits of Belle Isle, Davis Straits, Baffin Bay, and Smith Sound. On board he has a *minimum* number of white men, who will be supplemented by Eskimos and dogs when he reaches the Whale Sound region, and he will endeavour to force the *Roosevelt* to the same, or similar, winter quarters on the north shore of Grant Land that he occupied in the winter of 1905-6. Wintering there, Commander Peary says, will be essentially the same as before, though he expects to avoid the distribution of the dogs and a large portion of his party through the interior of Grant Land during the winter, which was enforced on him in the last expedition by the poisoning of the whale meat purchased as food for the dogs. The sledge work will begin as before (in February), but the route will be modified, for the party will follow the north coast of Grant Land as far west as Cape Columbia, and possibly beyond, instead of leaving the land at Point Moss. When Commander Peary leaves the land the course taken will be more west of north than before, in order to counteract or allow for the easterly set of the ice between the north coast of Grant Land and the Pole, discovered during his last expedition. Another essential modification will be a more rigid massing of the sledge divisions *en route*, in order to prevent the possibility that a portion of the party may be separated from the rest by the movement of the ice, with insufficient supplies for a protracted advance, which happened in the last expedition.

"There is no doubt in my mind," says Commander Peary, "that the 'big lead' encountered in both my upward and return marches in my last expedition, which was also observed by me in 1902—although closed at that time—is an essentially permanent feature of this part of the Arctic Ocean. This lead extends westward from Cape Morris Jesup, the most northern point of Greenland, in the general neighbourhood of the eighty-fourth parallel, toward Crocker Land, and forms the line of demarcation between the heavy, rough, nearly motionless ice embayed in the great bight between Cape Jesup and Crocker Land, and the less heavy, more mobile ice of the central polar sea, moving steadily from the ice-encumbered areas north of Behring Strait, and across the Pole toward the North Atlantic in a broad stream between Cape Morris Jesup and the northern point of Franz Joseph Land."

Commander Peary has little doubt of his ability to make this lead (that is, from the 84th parallel) instead of from the north coast of Grant Land (83 degrees North latitude), his point of departure, with fully loaded sledges. If this is done, it will shorten the route by nearly 100 miles, and distinctly simplify his task.

On the return voyage, he says, he will probably do voluntarily what he did involuntarily last time—that is, retreat upon the north coast of Greenland (a course diagonally with the set of the ice), instead of attempting to come back to the north coast of Grant Land (diagonally against the set of the ice).

An adjunct to this programme will probably be the establishment of a depôt well up the north coast of Greenland by the first supporting parties returning to the ship. This would simply be a precautionary measure, as the explorer's personal acquaintance with the entire north coast of Greenland, and the east coast as far south as Cape Parish, would permit the subsistence of a small party upon the game of the region. Such a depôt party might be able to extend his surveys of 1900 south from Cape Parish to Independence Bay and possibly beyond, and would be able to explore the exterior ramifications of the great Greenland ice fjords debouching into the central Polar sea between Cape Bryant and Cape Morris Jesup (presenting the most boreal manifestations of glacial conditions in the world), and bring back a synopsis of the fauna, flora, and geological features of this coast.

It may also be possible for the second detachment of returning parties to go west from Cape Columbia along the north coast of Grant Land to Cape Colgate, and perhaps Cape Thomas Hubbard, and thence to Crocker Land, for the exploration of this new section of the unknown Arctic.

Commander Peary points out a distinct advantage which exploration in this direction possesses. It is that the party, when once it regained Cape Colgate, would be independent of the sea and ice movements as regards travelling. The broad glacial fringe of North Grant Land, which he found in his last expedition extending west from Cape Hecla to Cape Colgate, and south-west from Cape Thomas Hubbard, is an imperial highway, second only to the "inland ice" of Greenland, and is available for travel throughout the entire year, with the exception of about three weeks in July, at the height of the Arctic midsummer, when it is an almost impracticable labyrinth of deep lakes and rushing glacial streams, formed by the rapid melting of the snow.

The two auxiliary routes indicated above mean the investigation of the most Northern coastline in the world (situated only about 500 miles from the Pole itself) through, possibly, 100 degrees of longitude.

In view of the fact that in his last expedition he personally covered, within the limits of a single sledging season, one half of the range (both latitudinally and longitudinally) contemplated in the above outline, Commander Peary believes it not too imaginative to assume that the programme, as outlined, could be carried out by three simultaneous parties, utilising his methods, and guided by his personal acquaintance with the greater portion of the route traversed by each.

The explorer is taking light sounding apparatus with his advance parties, and will make every effort to obtain a line of soundings from the north coast of Grant Land to the Pole, which may determine the general feature of sea-depths in this region and the position of the continental shelf north of Grant Land and Greenland.

An effort will also be made to obtain tidal observations at salient points on the long stretch of coastline between Cape Morris Jesup and Cape Thomas Hubbard (nearly 75 degrees of longitude). These operations should throw additional light upon the present discussion of tides in the central Polar sea, and on their relation to unknown land masses in the at present unexplored area. His personal knowledge of the entire coast between these limits and the ability to traverse it at comparatively high rate of speed will, he believes, make such observations possible.

General.

Quebec Meteorological Conference.—The conference of meteorologists representative of the United Kingdom and of the British Colonies and dependencies, which, as noted in our May issue (p. 267), it was proposed to hold in Quebec during the last week of July, did not take place, having been postponed till next year.

The Respiration of an Inland Lake.—A very instructive paper with this title appears in the *Popular Science Monthly* for April, and aids greatly in the interpretation of some of the results of the survey of Scottish lochs, published here during the last few years. The author, Prof. E. A. Birge, compares an inland lake to a living organism. The comparison has of course been previously made more than once, but the special point here is the comparison as regards the intake and egress of gases—a matter of great importance in regard to the fauna, and especially the fish fauna of lakes. The two important gases, in the lake as in the organism, are oxygen and carbonic acid, the absorption and discharge of nitrogen being of no apparent importance. The great point as regards oxygen is that the power which the water possesses of holding gases in absorption diminishes with a rise of temperature, and is thus greater in winter than in summer. In the late autumn, in North American lakes, the water becomes uniform in temperature from top to bottom, the exact date varying with the local conditions. When it is thus of uniform temperature the water is very readily stirred throughout its whole depth by the wind. It is also cold, and the combination of the two causes means that in late autumn the oxygenation of the water is very complete. The period of oxygen absorption in North America is followed by a period of quiescence, due to the winter coating of ice. During this period the access of new oxygen from the air is prevented by the covering of ice, and the living inhabitants of the lake must depend wholly upon the existing supply, especially as the plants are virtually inactive at this period, and can thus not produce new oxygen. In spring there is a period when the temperature of the water is again uniform from top to bottom, and when oxygen absorption is therefore

rapid. But this period is short, for the temperature is constantly rising, and this diminishes the power of absorbing gases, while the rising temperature of the air induces stratification of the water, which makes wind movement and circulation difficult. Finally, as the warm season is established, the lake water is completely separated into an upper warm layer, varying in depth from 10 to 12 to 30 to 40 feet according to the depth of the lake, and a lower cold layer. The upper layer is constantly put in movement by the wind, and it may be saturated with oxygen or nearly so. The lower layer is not reached by the wind, and has to depend for its supplies of oxygen upon diffusion, a slow and ineffective process, and convection currents, which in full summer act only to a very slight extent. Further, the inhabitants of the upper layer of water as they die and decay sink downwards, and their decomposition makes further demands upon the already small oxygen supply of the deeper layers. The result is that in deep lakes the cold bottom water becomes unfit for higher animals early in the warm season, and this greatly diminishes the possible number of animals in such lakes. These observations and deductions lead to the conclusion that it is rather the supply of bottom oxygen than the food supply which determines the fauna of a lake.

The above takes no account of the oxygen produced by plants. Some careful observations on lakes in the States have shown that the result of plant activity is to greatly increase the supply of oxygen in the upper layers of the cold water. This can only occur if the surface warm layer is thin, as otherwise plants cannot obtain sufficient light, but when this condition is fulfilled it is found that algae thrive abundantly in the upper layers of cold water, and thus make these habitable to certain animals. But the oxygen-producing effect of plants is limited to the upper layers of cold water, and does not affect the bottom layer.

By a somewhat similar line of argument the author shows that there is reason to believe that in those layers of water which are suitable for the growth of algae, the carbonic acid so necessary to these may be deficient in amount, and thus diminish the possible amount of algae. In general it seems clear that on account of the imperfection of the mechanism for circulation of water in freshwater lakes, life is rendered more difficult than it would otherwise be, this being especially true of deep lakes, whose cold depths, says Professor Birge, swallow almost all the products of the summer's growth, and only give them back in late autumn when the season for active life is passing away. The paper, a strikingly interesting one, contains some other points in addition to these discussed above.

NEW BOOKS.

ASIA.

Winter Days in India and Elsewhere. By William George Black. Privately printed. Glasgow: James Maclehose and Sons, 1908.

The author of this pleasant little volume left Glasgow on 6th November 1906, spent nearly three months in India and Burma, and returned by Singapore, China,

Japan, Canada and New York on 10th July 1907. The book was written in the form of letters to the *Glasgow Herald*, and much of it was also delivered before the Church of Scotland's Elders Associations in Aberdeen and Glasgow. The author's powers of observation are only equalled by his common sense and charity to all men. We recommend the book to all who contemplate a tour in India and the Far East. It should also tempt many who go no further every year than the Mediterranean and Egypt to set forth to see the great peoples, civilisations and cities of our Indian Empire.

AFRICA.

La Grande Ile de Madagascar. Par Marius-Ary Leblond. Paris: Ch. Delagrave, 1908.

This large well-printed, well-illustrated volume contains chapters which originally chiefly appeared in *La Revue des Deux Mondes.* An excellent orographic map of the island is prefixed. The Districts, Races, Manners, Festivals, Poetry, Art, Beliefs, the Civilisation of the Ox and Rice, and the natural resources of Madagascar are successively discussed by the author, who states that he had traversed the island only after having read everything that had been written on it. The bibliography he appends beginning with some Ancient Descriptions, published 1603-51, and Defoe's *King of the Pirates*, published in 1719) shows how extensive his reading was. He informs us that the Malgaches, the inhabitants of Madagascar, belong to "the poetical races, capable only of minute and varied labour, without much physical power of action; and the excessive activity to which they are subjected can only exhaust them and enrich their graveyards, destroying the indigenous humanity as the English have destroyed the Australians and Tasmanians in their great islands under the same latitudes. Now, our nation of intellectuals and soldier artists is not made for such a work, and the Malgaches, on their side, have much more precious qualities in reserve than the South Sea Islanders. From their poetry, their musical genius, the subtlety of the people of the Centre, the robustness of those of the South, our rule may obtain a race more pliant than energetic but able to extract from that great poor country the maximum of riches, resulting in an incomparable diversity of products rather than in a number of materials most precious to European civilisation."

South Africa at Home. By Robert H. Fuller, late Headmaster, Dale College, King Williamstown. London: George Newnes, Ltd., 1908. *Price 5s. net.*

Mr. Fuller's genial eyes see everything in South Africa *couleur de rose* and he is even able to assure us that the climate of Johannesburg is one of the most delightful in the world. He shows us, however, and we welcome it, the great change for good which has been wrought throughout the area of the late war. The unprogressive Boer has been shaken out of his solitude, the concentration camps started education, and now "no one can read the *Transvaal Educational News* without feeling that a new life is abroad in the land." Of Bloemfontein Mr. Fuller says: "The English will allow no anti-Dutch talk, and the Dutch seem to foster no ill-will toward the English." The young Dutchman, particularly in Cape Colony, is thoroughly British in his sports. The native question, however, is a serious one, and at present affairs are in a state of flux. The religious movement recently imported from the negroes of the United States and the occasional public assertion that the land belongs to them by the natives give cause for watchfulness, especially in Natal, where the black population outnumbers the white by twelve to one.

While the book deals with geographical, commercial, and other features, it naturally gives special prominence to the social and domestic side. Mr. Fuller mentions on the one hand such a strange invitation among the old Boers as "come and see my husband die," and on the other hand the convenient ladies' practice of calling by means of cards left at a central club. There is abundance of anecdote, and the tone throughout is kindly and humorous.

Tramps Round the Mountains of the Moon and Through the Back Gates of the Congo Free State. By. T. Broadwood Johnson, M.A., F.R.G.S. London: Fisher Unwin, 1908. *Price* 6*s.*

Since 1890 the British Government has made itself responsible for the Protectorate of Uganda. It was fifteen years before that that Henry Stanley (in 1875) wrote his famous missionary letter from the court of King Mtesa, who called for Christian teachers. Marvellous has been the progress made by the people under the influence of Alexander Mackay and the other agents of the Church Missionary Society. The story of the kingdom of Uganda is comparatively well known, but this is not the case with the other four provinces of the Protectorate. This most interesting volume by one who has tramped the country round Ruwenzori and into the Congo Free State for five years, reveals the condition of Toro and the Western province, under its now Christian sovereign Daudi Kasagana. The missionary and the British Commissioner have combined to Christianise the people without denationalising them. Mr. Johnson enables us to see the process at work in great detail, and contrasts it with the administration of the neighbouring state, to the disadvantage of the latter. It would appear from Mr. Johnson's work that excellent progress is being made in the Uganda region.

AUSTRALASIA

Stanford's Compendium of Geography and Travel (New Issue). Australasia. Vol. II.—Malaysia and the Pacific Archipelagoes. By F. H. H. Guillemard, M.A., M.D. Second edition, revised by A. H. Keane, LL.D. Maps and Illustrations. London: E. Stanford. *Price* 15*s.*

The first edition of this book was noticed in *The Scottish Geographical Magazine* for February 1895. The form, paging, letterpress, maps, and illustrations (with one exception) of that volume are reproduced in this new issue. Some modifications, additions, and omissions, concerned with statistics of area, population, trade, and the like, with discoveries due to recent explorations, and with political changes and arrangements of territory, have been made. These have, from a mechanical point of view, been skilfully introduced or made in the text. Otherwise, the compilation stands as it did in 1895, and calls for no further notice.

It may be permitted to restate one remark made in the notice of that year, namely, that the value of the book would be much enhanced were a bibliography—it need not be a lengthy one—added to the different articles, of the authorities which have been consulted in compilation, and to which students wishing to consult original works and papers might be referred.

Why the portrait of the Samoan chief, which forms the frontispiece, is referred to on pages 8 and 22 in connection with the Malays is not quite clear. In the first edition the portrait of the Sultan of Sulu, Philippine Islands, formed the frontispiece. He doubtless was a Malay of sorts; as such a Samoan can hardly do duty for him.

POLAR.

The North-West Passage: Being a Record of a Voyage of Exploration of the Ship Gjöa, 1903-1907. By ROALD AMUNDSEN. With a Supplement by First Lieutenant HANSEN. 139 Illustrations and 3 Maps. 2 volumes. London: A. Constable and Co., 1908. 31*s.* 6*d. net.*

For more than two hundred years the hope of finding a passage to the East by north-west or north-east was the chief stimulus to north polar exploration, and it was only when the Franklin expedition and subsequent search expeditions proved the hopelessness of practical navigation to the north of America that interest in the North-West Passage waned. Perhaps, therefore, it was not surprising, when the little *Gjöa* with Roald Amundsen and his companions reached Nome, in Alaska, in the summer of 1906, that the event roused little enthusiasm beyond the circle of geographers and polar travellers. Yet the accomplishment of this voyage by *one* ship was a striking event in the annals of exploration, and Amundsen has deserved more fame than has fallen to his lot. The *Gjöa*, a tiny boat of forty-seven tons with a 13 H.P. petroleum engine, left Christiania in June 1903, and entered Lancaster Sound in August. Thence *via* Barrow Strait and Franklin Strait she reached King William Land and the vicinity of the Magnetic Pole, whose location was the chief aim of the expedition, according to its leader. So far with the exception of one grounding they had no trouble, and the way was clear of ice after entering Lancaster Sound. The *Gjöa* passed between King William Land and Boothia Isthmus by Rae Strait to her winter quarters in Gjöa Haven, on the south-east of King William Land. Here two winters were passed, and a great deal of magnetic work was accomplished in the vicinity and as far north as Franklin Strait. In a safe harbour, with an abundance of game, and in the company of some sixty Nechilli Esquimaux, they seem to have passed these nineteen months in comparative comfort, and certainly without hardship or disaster of any sort. The presence of these Esquimaux was most fortunate, since the crew of the *Gjöa* was small, and was all the better for extra help in house-building, sledging, and hunting. On the return of Hansen from his long sledge journey to Victoria Land, the *Gjöa* left for the west. In parts of Simpson Strait she sailed over only three fathoms of water. Queen Maud Sea was full of ice, which necessitated much difficult and tortuous navigation through a group of islands, rocks, and reefs in its northern part. And here the value of a small ship was very evident, though we must give her crew credit for their excellent seamanship. Victoria Strait was full of loose pack, but was safely negotiated, and Dease Strait, though shallow inshore, was found to be deep in the middle. When once Cambridge Bay was reached Amundsen justly felt that the North-West Passage was virtually accomplished, since Collinson in 1850 had reached this point from the west in the *Enterprise*. The author pays a tribute to Collinson's work in the narrow straits south of Wollaston and Victoria Lands, and acknowledges the help he got from the description and maps executed on the *Enterprise*.

At Nelson Head, south of Baring Land, the first San Francisco whaler was met with, and thereafter several more were sighted or spoken until King Point, near the mouth of the Mackenzie River, was reached. Here the *Gjöa* was stopped by ice and passed her third winter. According to the whalers, King Point is a difficult place, and though the ice may occasionally break up as late as early October, they are often compelled to winter in the vicinity. Safe harbours on this coast are scarce, and the want of them has accounted for the loss of many ships. Nowadays the whalers always try to pass the winter at Herschel Island, where there is a good harbour on the east coast safe in all winds. About Herschel Island and

the mouth of the Mackenzie River twelve American whalers passed the winter of 1905-6, and most of these had a large proportion of negroes among their crews; they seem to have stood the winter well. At King Point the explorers came in contact with other tribes of Esquimaux, and were in touch with civilisation through missionaries and the North-Western Mounted Police. During the winter Amundsen, with several companions, made a trip on ski and snow-shoes to Eagle City to get into cable communication with Norway. From King Point the course lay along the coast of Alaska to Behring Strait. Ice obstructed the passage in several places probably owing to the early start, but more serious was the strong north-east current encountered on the route, especially at Cape Barrow. To escape this it was necessary to hug the coast. This, the author thinks, is the current that carried De Long's *Jeannette* to destruction: this, however, is doubtful. Ultimately Cape Nome was reached on August 31, 1906, and the North-West Passage was an accomplished feat.

The whole expedition was admirably planned and executed, and reflects the greatest credit on all concerned. Roald Amundsen's name will for ever be writ large in the annals of Arctic exploration.

The book is written in a pleasant and fluent style, and though, as in all such books, much detail is included, the pages are never monotonous. There is a spirit of enthusiasm and resolution throughout that makes it captivating reading, and it is pleasing to note the unstinted praise that the leader gives to his companions in the enterprise. Several chapters are devoted to an account of the Nechilli Esquimaux of King William Land and vicinity. They are one of the least-known tribes of these people, and have had practically no contact with white men, and Amundsen expresses the earnest hope that civilisation will never reach them. We can cordially echo these sentiments. It was from members of this tribe that Rae learnt of the fate of Franklin, and one of them told Amundsen that one of Franklin's ships was found on the south coast of Cape Crozier: the other probably was crushed and foundered off the group of islands in Victoria Strait.

We wish that the author had been more explicit as to the scientific work accomplished. We read much of magnetic work, but find no definite statement as to its results; perhaps it is still too soon to look for that. Lindström, the cook, made biological and geological collections with commendable keenness, and a good deal of coastline was mapped, especially around King William Land and the north east coast of Victoria Land, since named King Haakon VII. Coast. For the latter piece of work Lieutenant Hansen was responsible. But it is unfortunate that Amundsen should have used double and often triple names on his chart. The tendency to do this is responsible for some extraordinary names on polar maps. We must protest against such lengthy names as Cape Crown Prince Olav, King Haakon VII. Coast, Royal Geographical Society's Islands, and a host of others. The only consolation is that they must inevitably be pared down to single words in the course of time.

The volumes are well illustrated with photographs, have an excellent index and three maps. The maps are admirable as far as they go, but are inadequate to fully illustrate the voyage, and moreover contain no orographical details.

GENERAL.

Les Dépôts Marins. By Dr. Léon W. Collet. Paris: Octave Doin, 1908. *Price 5 fr.*

Dr. Collet has done good service in bringing up to date our knowledge of Deep Sea Deposits, for this is, we believe, the first work dealing with them in a general manner that has appeared since the memorable volume in the results of the voyage of the *Challenger*. Trained under Sir John Murray, to whom the work is

dedicated, the author has naturally adopted Murray and Renard's method of classification, giving, however, good reasons for his preference for it over the method suggested by Thoulet, which is based solely on the size of the mineral granules, independent of their origin or composition. All the latest work has been incorporated in the general map of the world, giving the distribution of the different types of sediment; the only pity is that the map could not have been produced on rather a larger scale. Formations of chemical origin receive large attention, particularly glauconite and phosphatic concretions, to which the author has devoted much personal research. Particularly interesting is the chapter dealing with coral formations, embodying as it does the views of Darwin, Murray, Dana, Agassiz and the more recent investigations of Gardiner and the Funafuti expedition. The last part deals with the formation of certain ancient sedimentary formations, both calcareous and silicious, and is based chiefly on the work of Cayeux. There is a good bibliography and index.

NEW MAPS.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 30th June 1908:—Two-mile Map. Printed in colours and folded in cover, or flat in Sheets. *Burnessan.*—Sheet 21. *Inveraray.*—Sheet 22. *Perth.*—Sheet 23. *Islay.*—Sheet 25. *Rothesay.*—Sheet 26. *Lanark.*—Sheet 27. *North Berwick and Kelso.*—Sheet 28. *Kintyre and Isle of Arran.*—Sheet 29. Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d. each. Special Map of Loch Fyne and Loch Lomond District. Parts of Sheets 21, 22, 25, 26. Price, on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d.

One-inch Map (third edition), engraved, in outline. Sheet 72, 73. Price 1s. 6d. Third edition, engraved, with hills in brown or black. Sheet 48. Price 1s. 6d. Third edition, printed in colours and folded in Cover, or flat in Sheets. *Perth.*—Sheet 48. Price, on paper, 1s. 6d; mounted on linen, 2s.; mounted in sections, 2s. 6d.

Six-inch and Larger Scale Maps.—Six-inch Maps (Revised), full sheets, engraved, without contours. *Caithness.*—Sheet 41. Price 2s. 6d. Sheets (15 and 21A), 36, (44 and 44A). Price 2s. each. *Sutherland.*—Sheets 19, 79. Price 2s. 6d. each. Sheet 8. Price 2s. Quarter sheets, with contours. Price 1s. each. *Edinburghshire.*—4A SW., 8 SE., 13 SE., 14 NE., 14 SE., 15 SW. *Haddingtonshire.*—2 NW., 2 NE., 3 NW., 6 NW., 6 SE., 9 SW., 10 SE., 12 NW., 12 NE., 16 NW., 19 NW.

1 : 2500 Scale Maps (Revised) with Houses stippled, and with Areas. Price 3s. each. *Edinburghshire.*—Sheets III. 1, 3, 7, 8, 9. *Peeblesshire.*—Sheets V. 5, XIII. 1, 5, 12, 14; XIV. 9; XVIII. 2, 9. Sheet XVIII.-A 1. Price 1s. 6d. *Wigtownshire.*—Sheets XXII. 8, 12, 15, 16; XXIII. 5, 13; XXIV. (6 and 1); XXV. 6, 7, 10, 11, 13, 15; XXVIII. 3, 4, 8, 12; (XXVIII. 16 and XXVIII.-A 4); XXIX. 1, 5, (6 and 2), 10, 13, 14; XXX. (2 and 1); XXXI. 13; XXXIII. 1, 2, 5, 6, 7, 9, 10, 13, 14, 15; XXXIV. 4; XXXV. 1, 5; XXXVII. (1 and 5), 2 3, 6, 7, 11, 12.

Note.—There is no coloured edition of these Sheets, and the unrevised impressions are withdrawn from sale.

GEOLOGICAL SURVEY OF SCOTLAND.—The following publications were issued from 1st to 30th June 1908:—Six-inch Maps. Quarter Sheets, uncoloured. Price 1s. 6d. each. *Edinburghshire.*—4A SW., 9 NW., 9 SW., 9 SE., 18 NE., 19 NW., 19 NE. *Haddingtonshire.*—9 NW., 9 NE., 9 SW., 9 SE., 14 NW., 14 NE., 14 SW., 14 SE.

THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE SURVEY OF THE BRITISH EMPIRE.[1]

By Major E. H. Hills, C.M.G., R.E.

The thirty years that have elapsed since the British Association last met in this city of Dublin have seen an obvious and rapid progress in the science of geography, and a steady though perhaps not quite so apparent a change in the character of that science.

In 1878 large parts of the earth's surface still remained untrodden by the feet of a white man; large areas were open to the enterprise and intrepidity of the explorer; large spaces were blank paper upon our maps. Now there is but little of the earth's surface absolutely unknown.

It is not my intention to detain you by any recapitulation of the work of these years to show you how and by whom these areas have been traversed and the gaps in our maps filled in. I intend rather to speak of the present and of the future work of the geographer, and to do this to any advantage we must at the outset recognise the change that has taken place in the nature of his task, and the fact that the days of individual exploration are over, never to return. We must recognise that sporadic, unorganised effort must be and is being replaced by organised, systematic work, and that the scientific traveller of the last century, with his rough map-making equipment, his compass, watch, and sextant has yielded his place to the scientifically equipped survey-party with their steel tapes, theodolites, and plane tables.

The theme is not a new one to this Section. I find on referring to the transactions of past years that in 1902, at the Belfast meeting, Sir

[1] Presidential Address to Section E (Geography) delivered at the Dublin Meeting of the British Association.

Thomas Holdich, the President of Section E, said: "We find those spaces within which pioneer exploration can be usefully carried out to be so rapidly contracting year by year as to force upon our attention the necessity for adapting our methods for a progressive system of world-wide map-making, not only to the requirements of abstract science but to the utilitarian demands of commercial and political enterprise."

These words express succinctly the ideas that I wish to take as the text of my address to-day. I am, however, not ambitious enough to attempt to cover the whole surface of the earth in the brief review that I intend to put before you of the progress of scientific survey. Rather I wish to restrict our outlook to that section of the work in which we may all be considered as having a direct personal interest—namely, the survey of the British Empire, especially those lands under the more immediate tutelage of the Government of this country. Let it not be thought, however, that while we for the moment pay little attention to the regions lying outside this definition, we are supporting the fallacious idea that the survey of any part of the earth can be considered apart from the survey of the surrounding country. With the possible exception of the case of an oceanic island such an assumption would be an erroneous one. Our British Empire is so widespread and our possessions are so often in close and intricate juxtaposition with those of other nations that there is in this work large scope, and indeed necessity, for international co-operation. Examples of this will occur to us in the course of our review. We shall thus see that in addition to the obvious connection which the geography of our Empire has with that of other countries, there is an even closer connection in the methods of manufacture of that geography, which methods we summarise under the general term of survey. One of the root ambitions of the scientific surveyor is to determine the exact figure of the earth, an operation for which observations spreading over a large area of the earth's surface are demanded. In fact we may truly say that the problem of the earth's shape will not be completely solved until the whole surface is known to the surveyor. This is, therefore, pre-eminently a problem for international solution.

Before proceeding to the consideration of our special subject, the survey of the British Empire, it will be interesting to interpose a few remarks on the questions of the utility and origin of national surveys in general. We may first note the somewhat curious fact that the production of a map of a country, useful as such a work is for many purposes, has almost always been embarked upon because the imperative necessity of maps of the theatre of operations in war has been brought home to the people and government of a nation. Thus the ordnance survey of England had its first beginning in a military map of the Highlands of Scotland, commenced in 1747, intended to facilitate the operations of the troops under the command of the Duke of Cumberland. It was not till many years later that the systematic triangulation of the country was undertaken, a work which was initiated partly for map-making and partly for astronomical purposes. There was a consensus of opinion among astronomers that it would be greatly to the advantage of that science if the observatories of Greenwich and Paris could be connected

by triangulation, and the famous French astronomer Cassini, in October 1783, drew up a memoir to this effect. The arguments brought forward convinced King George III., and he granted a sum of money sufficient to enable the work to be started. This act of royal generosity was recorded by the surveyors in the following grateful terms: "A generous and beneficent monarch, whose knowledge and love of the sciences are sufficiently evidenced by the protection which he constantly affords them and under whose auspices they are daily seen to flourish, soon supplied the funds that were judged necessary. What his Majesty has been pleased to give so liberally it is our duty to manage with frugality consistent with the best possible execution of the business to be done."

It is worthy of remark that the junction of the triangulation systems of Great Britain and France was not made until 1861, and that the trigonometrical connection of Greenwich and Paris observatories has not yet been completed to the final satisfaction of men of science, a point which we shall have occasion to recur to later.

In France, we may note in passing, the starting of the triangulation had a quite different and quite definite object, the determination of the length of the metre. This unscientific unit of length was fixed as a fraction (1/10,000,000) of the quadrant of the earth's surface between the Pole and the Equator, and to find this quantity it was necessary to measure on the earth's surface as long an arc of the meridian as could be obtained.

In the case of our other great national survey, that of India, its origin is to be found in circumstances somewhat analogous. The Madras Government, owing to the success of the British arms in the Mysore campaign, found itself with a great accession of totally unsurveyed country in the middle of the Peninsula, while at the same time there were only in existence the roughest sketch-maps of the older possessions. It was apparent that if any map, of even approximate accuracy, was to be made covering a country of such vast area, it was imperative that the work should be prosecuted upon the most rigorous and strictly scientific basis. The general lines upon which it should be undertaken were laid down in February 1800 by Brigade-Major Lambton, who addressed a letter to the Madras Government advocating a mathematical and geographical survey of the peninsula.

In this letter he discussed the principles upon which such a survey should be based. He dismissed astronomical fixations as not providing the requisite degree of precision, observing that such determinations of position are liable to great inaccuracies, "three, four, perhaps ten minutes," and proposed a triangulation emanating from a measured base line checked by similar base lines at intervals. He recognised that the figure of the earth and the lengths of the polar and equatorial radii were not then known with the precision necessary for fixing the spheroidal co-ordinates of the trigonometrical stations of a survey covering such a large area of the earth's surface, and that a geodetic survey was therefore necessary *pari passu* with the geographical survey. He had an impression, how derived it is not now possible to say, that there was

a sudden abnormal diminution of the force of gravity at the latitude of 10° north, and consequently that "a degree on the meridian from that parallel to the Equator must be very short compared with a degree to the northward of 10°." He observed that it would be necessary to "attend to this circumstance," which he characterised as important both from the map-making and from the rigorously scientific point of view. He added: "I shall rejoice, indeed, if it should come within my province to make observations tending to elucidate so sublime a subject."

In a similar case, occurring in recent years, the outcome has not been so satisfactory. It will be within the recollection of all here how at the time of the South African War the public at home learnt with shocked surprise that there were no maps in existence of a colony which had been under the British flag for a long period of years. To those who knew the facts this was, naturally, no matter of surprise; but it was earnestly hoped by many that the grave deficiency thus revealed by the stress of war would be remedied by quiet work in the time of peace and that, at the conclusion of the military operations, the foundation should be laid for a federal survey department of British South Africa comparable with, though on a more moderate scale than, the Survey Department of India. This hopeful scheme, which it may be recorded very nearly came to fruition, ultimately found political conditions too adverse, and had to be indefinitely postponed. An army engaged in field operations in the north of Natal now, or in fact at any time for an indefinite number of years in the future, would find the country nearly as mapless as it was found by Sir R. Buller in 1900.

In this short recital of the determining causes which have in the past led to the initiation of national surveys, it will have been noticed that no allusion has been made to what we should now perhaps consider the main utility of a map—namely, its value for all purposes connected with the ownership, development, and taxation of land. When the ordnance surveys of Great Britain and Ireland were originated there was little thought of this use, and it was not till long after that period, when the enormous deficiencies of the existing property plans were revealed by the Tithe Commutation Acts and by the railway boom, that the value of a national survey for preparing a cadastral or large-scale property map of the country was recognised and acted upon. Now this is often the ostensible object for embarking upon a regular survey. It is fully recognised that, especially in the case of a country undergoing rapid development, which is fortunately true of many of our oversea possessions, the provision of an accurate land map is of prime necessity both to the private or corporate landowner and to the State.

Neither were any of the early surveys undertaken for the purpose of mutual delimitation of international boundaries; a necessity which has in recent years been the stimulating cause for many pieces of valuable survey work, especially in Africa.

The other manifold uses of a map are familiar to all of you, and we need not pause to enumerate them. We may admit the fact that the adequate mapping of its territories is recognised as one of the duties of

a civilised State. Let me now turn to the main subject of this address —the inquiry as to how far this duty is performed by us, what shortcomings we can perceive, and what suggestions we can offer for the future.

Two years ago this task would have been a difficult and laborious one. Now it is greatly facilitated by the issue from the Colonial Office of those excellent little volumes, the reports of the Colonial Survey Committee.

This body has been in existence since August 1905, and has published three annual reports. The Committee is therein defined as an advisory one formed at the instance of the Secretary of State for the Colonies, to advise him in matters affecting the survey and exploration of British colonies and protectorates, more especially those in tropical Africa. It is not at present an executive body, that is to say it has at its own disposal no grant of public money or other funds; whether it will ultimately develop into such is a question that the future alone can answer. Even thus limited in scope and powers it has, however, already worked a notable improvement—firstly, by laying down authoritatively some of the more salient conditions that ensure the efficient and economical expenditure of whatever funds may be available, and by pointing out the disastrous extravagance of unsystematic and unmethodical work; secondly, by insisting upon uniformity where uniformity is essential, such as in matters relating to the style, projection, scales, and sheet-lines of the maps produced, while leaving the utmost latitude as to methods, these being selected in each case to suit the very divergent nature of the country met with. It results from this that any two small portions of the map of Africa, say, for instance, one sheet of the dense forest region of the Gold Coast and another of highland country of East Africa, though 3000 miles apart and executed at different times by a different staff, will match each other in general character, and will ultimately be found to fit exactly into their places as constituent parts of a great map of the country. Thirdly, we may reckon the mere fact of publicity in these matters as of no mean advantage. Though, as in the case of many other Government publications, this report is not as widely read as its merits deserve, yet it is all to the good that the information is there ready and available for anybody who has the curiosity to consult it. I therefore welcome the opportunity of drawing your attention to this volume.

In entering upon the discussion on the survey of British Africa, the first point that meets us is the geodetic basis of the whole work; upon what do the actual positions depend? In other words, to put the matter more familiarly, how are we to provide that every isolated piece of the map will exactly fit into its proper place? The only method for ensuring this is by basing all our surveys, ultimately, upon a skeleton or framework of geodetic or primary triangulation executed with the utmost attainable precision. Such a skeleton, or rather backbone, will eventually exist in Africa in the shape of the meridional arc, or chain of triangles, along the thirtieth meridian, running right through the country from north to south, and ultimately joining on to the great

arc observed by the famous astronomer Struve. This originally extended from the mouth of the Danube to Hammerfest, in Norway, an amplitude of 25½° of latitude. To prolong it southward, passing up the Nile Valley, through the heart of tropical Africa, across the Zambezi River, and terminate it at the southernmost point of the continent, is a magnificent conception due to Sir David Gill, to whose energy and enterprise the actual execution of considerable sections of the undertaking must also be ascribed.

At the present time the chain has been completed from the south to within seventy miles of the southern end of Lake Tanganyika, a distance of about 1700 miles. At Lake Tanganyika it will enter into German territory. The German Government, fully recognising that the project is not only of great theoretical interest, but also of immediate practical value, are already taking steps to start work on their own section, from the south of Tanganyika up to the parallel of 1° south latitude. From 1° south, northward to about 1½° north, the arc lies near the boundary between the Congo Free State and the British Protectorate of Uganda. An International Commission is at present engaged in the survey of the boundary region, and Sir D. Gill, ever ready to seize an opportunity of forwarding the work he has at heart, succeeded in raising sufficient funds, partly from the Treasury and partly by grants from a few leading scientific societies, to enable an observer to be sent out with this Commission to carry the arc over this section. North of this point the line comes into the territory of the British Soudan, and traversing this eventually reaches Egypt proper. Here it comes into the charge of Captain H. G. Lyons, the director of the Survey Department of Egypt, under whose care its interests are safe.

It will thus be seen that while the actual completion of the whole chain is as yet somewhat remote, we are in the satisfactory position of being able to say that, as far as the section lying on the continent of Africa is concerned, there is no portion of which there is not a reasonable probability that it will be finished within a measurable period. With regard to the section joining Africa and Europe the position is not so happy. This will run through Palestine and Asia Minor and therefore lies in Turkish territory. It is not likely that the Turkish authorities either will or could carry out such a work; in fact, seeing that even when completed it would be totally useless to them, it would be hardly reasonable to expect them to do so. It must, therefore, presumably be a matter for international co-operation. One point may be mentioned with regard to the exact route of this connecting section. Sir D. Gill, in his report on Geodetic Survey of South Africa, 1896, said: "By an additional chain of triangles from Egypt along the coast of the Levant, and through the islands of Greece, the African arc might be connected by direct triangulation with the existing triangulation of Greece, and the latter is already connected with Struve's great arc of meridian which terminates at the North Cape in latitude 71° N. The whole arc would then have an amplitude of 105°. This, however, gives rather a poor connection with the European triangulation. The South Albanian series

has a much higher average error than either Struve's original work or any part of the African series. This portion would consequently be a weak link in the geodetic chain, and it would be better to avoid it altogether by carrying the line along the coast of Asia Minor to Constantinople, and then up the east side of Turkey to the mouth of the Danube.

When we look back a few years and call to mind the prominent part that this country has taken in the survey of Palestine—I need only mention in this connection the names of Kitchener, Warren, and Conder—we cannot avoid a feeling of regret that we are not ourselves in a position to take the whole execution of this section of the line upon our shoulders. I am too well aware of the many urgent claims upon the Treasury to suggest that it is possible that they would be prepared to incur such a charge; but supposing, for the moment, that part of the necessary funds could be provided from other sources, I think we may fairly urge that it is our duty to contribute a substantial monetary grant towards the furtherance of an end so desirable and so practically useful.

The difficulty of obtaining money for geodetic work, the benefit of which is not immediately apparent to the man in the street, is notorious. Thus Sir T. Holdich, in 1902, said: "But this accurate framework, this rigorously exact line of precise values which ultimately becomes the backbone of an otherwise invertebrate survey anatomy, is painfully slow in its progress, and is usually haunted by the bogey of finance. It does not appeal to the imagination like an Antarctic expedition, although it may lead to far more solid results, and it generally has to sue *in formâ pauperis* to Government for its support." To account for this regrettable, but undoubtedly true, fact two reasons may be adduced. There is, in the first place, the possible ignorance as to the ultimate value of the work; but, secondly, and perhaps not least, there is the fear, not entirely unjustified, that to satisfy the demands of the scientific man is something akin to the operation of filling a sieve with water. It has been so often seen that compliance with one demand only leads to another being made, that we may well sympathise with the holder of the public purse when he draws the strings tight and refuses to pay for an arc along the thirtieth meridian in the fear that directly this is completed he will be asked to pay for one along the twentieth meridian, and then along the tenth, and so *ad infinitum*. It behoves us, therefore, as practical men to make sure that our demands are reasonable and limited to the actual requirements of the case, and where such limits cannot be set we should make this fact clear at the outset. When, however, it is possible to set such limits, we should not hesitate to do so; and in the case of the African arc this latter course is fortunately possible.

If we take the map of Africa we shall see that the arc along the thirtieth meridian passes through or near all the colonies of British South Africa, close to British Central Africa, or Nyasaland, through Uganda, and is thus connected with British East Africa, through the British Soudan and through Egypt. There remain absolutely untouched by it only the West African colonies—Nigeria, the Gold Coast, Sierra Leone, and the Gambia. These latter will eventually get their geodetic framework by an extension southwards of the French triangulation of Algeria,

a work of a high order of precision. We are therefore entitled to say—and I take this opportunity of saying it with all due emphasis—that with the exception of some triangulation to join the West African colonies with the French triangulation, the arc along the thirtieth meridian is the only primary triangulation required for the adequate mapping of the whole of British Africa. The remainder of the geodetic framework can be supplied by ribs of secondary triangulation branching out from the main backbone, such as the line already completed along the boundary between British and German East Africa, passing to the north of the Victoria Nyanza and thence westward to the thirtieth meridian.

You will observe that I here speak only of the triangulation required for mapping purposes, not of that demanded by the geodesist for the study of the figure of the earth. The latter is satisfied only with a survey of the highest attainable precision covering as large an area of the earth's surface as possible, or at all events with arcs, both meridional and longitudinal, at frequent intervals. It cannot be other than a very long period before the whole of Africa is surveyed upon this scale of accuracy, and in the meantime we must devote ourselves to the far more urgent duty of mapping the country, leaving the more remote and abstract task to our descendants, well satisfied if in our hands the foundations have been well and truly laid.

Furthermore, as we shall see presently, if we are prepared to recognise as a national duty the minutely precise survey of our own land and of all territories under our flag—and I do not see how any reasonable man can withhold this recognition—then there are duties of this nature lying closer to our hands than any to be found in Africa.

Having thus passed in brief review the ultimate geodetic basis of our African surveys, let us enter more into detail and glance at the actual survey work now in progress in the different regions of the continent.

In British South Africa, as we have already noted, the political conditions are at present unfavourable to any comprehensive scheme of operations. There is, however, in progress a first-class topographical survey of the Orange River Colony and a reconnaissance survey of Cape Colony. The former is an excellent example of the class of work that can be done by a small military party of the highest technical training working upon systematic lines, and I should like to devote a few minutes to a short description of the methods adopted and of the results obtained.

The survey party consists of two Royal Engineer officers and four non-commissioned officers, the former undertaking the triangulation and the general supervision of the field work, and the latter the plane tabling. The positions are primarily based upon the points of the geodetic survey broken up into a secondary triangulation with sides averaging ten miles. In 1907 the average triangular error of the secondary work was 2·9 seconds of arc, and the greatest linear errors of displacement, as tested by the geodetic triangulation at the end of a chain forty-five miles long, were three feet in latitude and two feet in longitude. The probable error of a trigonometrical height was under a foot. You will see therefore that the accuracy is ample for all mapping purposes, even upon large

scales, and the degree of precision is in excess of that demanded for a topographical map on the scale of two miles to an inch. The rate of progress and the low cost of work are, however, no less notable than its accuracy. The actual rate of out-turn is about eight square miles per day per man, or for the whole party twenty-three square miles of detail survey per diem, and the number of trigonometrical points fixed about three hundred per annum. The cost works out to about eight shillings per square mile of the completed map, and the whole area of 47,000 square miles will be finished, printed and published, in five and a half years.

These remarkable results are due in a large measure to the energy and organising power of the officer in charge, Captain L. C. Jackson, R.E. The detail survey is done in sheets fifteen minutes square, each non-commissioned officer being given one complete sheet, which he works at until finished. Four such sheets are therefore in progress at any given time, and each sheet takes about six weeks. Seeing the rapid rate of progress maintained it might perhaps be thought that the country is a particularly easy one for the topographer. Such is, however, by no means the case. It is true that there is an entire absence of the surveyor's greatest impediment, large areas of dense forest, but there is much broken and difficult country, rising in places to altitudes of above 7000 feet.

In Cape Colony the reconnaissance survey is of a somewhat similar character, but owing to the large area of the country and to the small amount of money available, the work has perforce to be of a more rapid nature. In Natal, Bechuanaland, and Rhodesia, no survey is at present in progress.

Passing northward through Africa, we come to the British Protectorate of Nyasaland, formerly called British Central Africa. Of this country a certain number of maps exist purporting to give topographical detail; but as they are not based upon any framework of triangulation, and as much of the detail only depends upon rough sketches, it is impossible to say how far they can be accepted as correct representations of the ground.

It is most unfortunate that financial considerations prevent the execution of any systematic trigonometrical survey. The absence of such, and the fact that maps are being made which must inevitably be withdrawn and replaced by others in the future, will undoubtedly be the cause of ultimate waste of money.

Passing northward again we come to the large and important protectorates of British East Africa and Uganda, in both of which systematic surveys are in hand. The geodetic framework is supplied by a triangulation along the Anglo-German boundary, connected with chains of triangles along the railway in the neighbourhood of Nairobi. In Uganda proper there is also a triangulation covering a substantial area. As already noted, all this work will eventually be tied into the thirtieth meridional arc, though it is not likely that the final adjustment of goedetic positions thus arrived at will necessitate any substantial alterations upon the maps.

In both protectorates topographical surveys are in hand, and maps

on the scale of two miles to an inch will be issued. In British East Africa, under the able direction of Major G. E. Smith, R.E., rapid progress is being made. This topographical mapping is additional to the cadastral maps also in progress in both countries. These latter are required for property purposes, in Uganda for demarcating the estates given over to the native inhabitants of the country under the agreement of 1900, and in East Africa for attachment to title-deeds of lands alienated for farming or stock-raising.

In the Soudan the enormous area of the country—over a million square miles—and the limited funds available have prevented any systematic survey being taken up. A large amount of reconnaissance mapping has been done, and a series of sheets on the scale of 1/1250,000 (four miles to an inch) have been published. These are corrected and improved by officers and Government officials as opportunity offers. The energies of the Survey Department are almost entirely spent in meeting urgent local requirements in the shape of cadastral maps of the cultivated areas along the river.

Somaliland, a British protectorate which came into unfortunate prominence a few years ago, is a country of too small value to be worth the cost of any sort of survey, and the only maps that exist are based upon the route sketches of travellers and sportsmen and upon the work done by a small section of the Survey Department of India during the military operations five years ago.

Leaving the east side of Africa and turning our eyes westward, we may note that in the colony of the Gold Coast a rigorous survey was rendered imperative by the gold-mining boom of 1901. The work was entrusted to Lieut.-Colonel Watherston, C.M.G., R.E. Owing to the dense forest covering practically the whole country, triangulation would have been prohibitive in price and very slow in execution. The initial positions were therefore fixed by a network of long traverses, executed with all possible refinements by steel tapes and theodolites. Astronomical latitudes were observed by Talcott's method at every fifty miles. The errors of misclosure of the traverses proved to vary from about 1 in 2000 in unfavourable cases to nearly 1 in 6000—results inferior to triangulation, but at the same time sufficiently accurate to form the basis of a map with no appreciable errors *on the paper*. One great defect of the traverse method of fixing points lies in the practical impossibility of carrying the heights through without occasional checking, either by lines of levels or by trigonometrical observations. Such work makes therefore an imperfect basis for topography, and would only be used when natural features compel its adoption.

Northern Nigeria is a country of enormous area, and, up to the present, of small revenue. It has therefore not been found possible to allocate the funds for any systematic mapping. The existing maps are compilations based upon sketches made by civil and military officers when travelling upon duty and upon the surveys made by the different Anglo-French and Anglo-German boundary commissions. In 1905-6, Captain R. Ommaney, R.E., fixed the astronomical longitudes of fifteen towns by exchange of telegraphic signals with Lagos. With the aid of these

values, combined with a number of astronomical latitudes, it has been possible to combine the material into something like a complete map. It need, however, hardly be pointed out that astronomical fixations are liable to large and uncertain errors, due to the variation of local attraction, and cannot attain the precision of even a rapid triangulation. In Southern Nigeria the experience has been somewhat unfortunate. This colony has spent a very substantial sum upon its survey department, and if the work had been properly organised and systematically carried out we should by now be in possession of a complete map of a large portion of the country. Unluckily, the mistake has been made of detaching survey parties for non-geographical purposes, such as the erection of telegraph lines, work doubtless urgently required in the interests of the colony, but not lying within the sphere of a survey department. Thus systematic progress was rendered impossible, and, though isolated pieces of triangulation and long lengths of traverses have been done, no topographical map of any area yet exists.

Of the remaining West African colonies Gambia river is a narrow piece of land with boundaries running parallel to the river banks, and, except for the actual trade along the river, is unimportant. In Sierra Leone the country in the immediate vicinity of Freetown was surveyed by the colonial survey section, a small party employed by the War Office for the purpose of making surveys of places of special military importance. The map of the remainder of the colony is a compilation based on miscellaneous material.

In the course of this summary of the state of the mapping of British Africa, mention has been made of the surveys made by joint commissions appointed for the delimitation of international frontiers. No small part of the existing map is due to work of this class. Thus joint Anglo-French commissions have marked out the frontiers of the Gambia, Sierra Leone, the Gold Coast and Nigeria: Anglo-German commissions the eastern boundary of Nigeria, the boundaries between British and German East Africa, between German East Africa and North-East Rhodesia from Lake Nyasa to Tanganyika, and between Bechuanaland and German South-West Africa; Anglo-Portuguese commissions the frontiers between Portuguese East Africa and North-East Rhodesia and Nyasaland respectively. Useful surveys have also been made in the course of the mutual demarcation of the frontiers between Abyssinia and the Soudan on the west and British East Africa on the south; also of the frontier between the colony of Sierra Leone and the Republic of Liberia.

Important as the work done by these commissions has been, its value would be greatly enhanced if the report of each commission was published in a succinct and easily accessible form. Such reports would naturally contain a record of the actual frontier as finally ratified, and also a technical account of the survey methods employed. They would thus be of permanent use both to the official or officer on the spot for the easy settlement of any disputes that may arise, and to the chief of any future boundary commission as an aid to the selection of the methods of survey most suitable to the particular country with which he is concerned.

Up to three years ago many of the African protectorates were under

the tutelage of the Foreign Office, while the older colonies were under the Colonial Office. The reports of Boundary Commissions are therefore scattered through official documents in the two offices, and are drawn up upon no uniform model. Now that the superintendence of all these territories has been handed over to the Colonial Office, and that body has set itself such an excellent example in the appointment of the Colonial Survey Committee and the publication of its reports, it is greatly to be hoped that they will follow up the good work and systematise and publish all these Boundary Commission reports. If a model for such a publication is desired, I may refer to the account of the demarcation of the Turko-Egyptian frontier between Rabah on the Mediterranean to the Gulf of Akaba, lately issued by the Egyptian survey.

The account which I have endeavoured to give you, short and imperfect as it is, of the present state of the mapping of British Africa will have shown you clearly that there is a large amount of excellent work now in course of execution, and that there has been, especially during the last few years, very considerable progress made towards co-ordinating this work and towards maintaining certain fixed standards of accuracy, rapidity and economy.

It will naturally occur to you to inquire whether this co-ordination could not advantageously be pressed a step further, and whether all the isolated survey departments, now working in the various colonies and protectorates, could not be amalgamated under one executive head; whether, in fact, a Survey Department of Africa, precisely analogous to the Survey Department of India could not be formed. The advantages of such a step are obvious, but must not be allowed to blind us to the difficulties. We have, in the first place, the objection to be met that the South African colonies would, under present circumstances, almost certainly refuse to join in any general scheme, and would not consent to any arrangement whereby money raised in one colony would be spent outside its own geographical limits. If, however, we leave South Africa out of the question, the financial difficulty tends to disappear. Both our East and West African possessions are, in general, not yet in a position to maintain themselves, and are still, and will be for some time to come, partially supported by grants from the Imperial Treasury. To divert a portion of these grants to pay for the maintenance of a survey department would only be a matter of account and could be adjusted so as to cause no hardship to any one colony. There remains the geographical difficulty of space. The fact that the heads of the department would have to keep in close personal touch with countries differing entirely in character, and perhaps three months' journey from each other, does not appear to offer any insuperable objections, and I cannot avoid expressing the hope that it may be found possible at a no very remote date to take some steps in the direction of a consummation which appears so desirable.

In giving my evidence before the Royal Commission on the War in South Africa, presided over by Lord Elgin, I outlined the general features of a scheme under which the Imperial Government would undertake the topographical mapping of all our oversea possessions, apart from self-governing colonies. As on this occasion I was considering the whole

question more exclusively from the military side, no reference was then made to the question of cadastral maps, and it was tacitly assumed that these would fall to be constructed by the land office or a land survey department belonging to each separate colony. On the present occasion we are not restricted to the military point of view, but are permitted a wider outlook. Our task is to consider the map in all its aspects, both as regards its method of construction and its ultimate use, whether for military, administrative, engineering, or purely scientific purposes. This enlargement of our scope does not, I think, modify our previous conclusions, and were I now called upon to devise a scheme for the mapping of British Africa, I should base it upon the principle of a central Imperial body for executing the triangulation and topography, leaving the land survey to local organisations.

The arguments in favour of this policy are manifold. As regards the triangulation they hardly require stating. It will be obvious to all that such work must be closely co-ordinated, and that some central, directing head is imperatively called for. The enormous waste of money that is ultimately involved by tolerating imperfect work, of which many examples could be cited, is alone a sufficient justification for holding this view. We may, however, pause to examine a little more closely into the advantages of centralisation as regards one particular operation in a survey. That is the measurement of the initial base line upon which the accuracy of the whole framework depends. This task used to be one of the most laborious and difficult with which the surveyor is confronted. The apparatus employed, some form of compensation bar, was cumbrous and difficult to use, the site selected had to be levelled, and the preparatory alignment carried out with the most scrupulous care. Thus the Loch Foyle base for the triangulation of Great Britain and Ireland was about six miles long, and the actual measurement, quite apart from the time spent on the preparation of the ground, took sixty days, an average rate of work of just over 500 feet per working day.

A few years ago the discovery was made of the nickel steel alloy with a very small or zero coefficient of expansion, the so-called invar. This valuable metal, by abolishing the necessity for any temperature correction, has enormously simplified all physical measurements of length, and, *a fortiori*, those measurements, such as base lines, which are perforce done in the open air and over a large range of temperature. Survey bases are now measured with an invar wire stretched to carefully regulated tension, and either laid along a flat trough, or what appears to give equally good results, hung freely between supports. The gain in precision due to the avoidance of errors of expansion or contraction in the measuring apparatus is substantial, while the gain in rapidity is very great. Thus, as a contrast to the Loch Foyle base, let me give a short account of the measurement of a base in Spitzbergen by the Russian party of the joint Swedish and Russian missions in 1900, extracted from a review already written for the *Geographical Journal*.

The conditions for accurate work were very unfavourable: no site even approximately flat could be found, and the base was therefore irregular in contour and traversed rough and in some parts marshy

ground. The weather conditions were far from ideal. The cycle of operations was as follows: An auxiliary base 175 metres long was measured with Struve's apparatus, twice before the main base measurement and twice afterwards. The two wires used for the main base were standardised on this subsidiary base four times, twice before and twice after use. The main base, 6·2 kilometres long, was measured twice in each direction by each of two wires, eight measures in all. The limit of error in the final value was 17 millimetres—say, one part in 360,000.

The whole of these operations, including the laying out of the standard and the comparison of the wires, were completed in a period of three weeks; Monsieur Backlund, who superintended the actual measurement, left the observatory at Pulkowa on June 11 and returned to it on July 24. It was therefore possible to standardise the wires not only by the check base upon the spot, but also by the permanent standards of the observatory within three weeks of their use for the actual measurement. It need hardly be pointed out that this was eminently favourable to the attainment of the highest exactitude, and we have here a marked example of the value of centralisation. The proposed trigonometrical survey department of Africa would probably find it advantageous to adopt similar procedure, and, instead of trusting a base measurement to a local staff unacquainted with the work, it would send out one or two men of highly trained technical skill equipped with the best apparatus. The money spent in journeys would be more than saved—firstly, by the unquestionable gain in accuracy and the consequent avoidance of the costly necessity for repeating bad work; and, secondly, by the gain in time, due to the fact that the local staff would not be called upon to learn the use of an unfamiliar set of instruments.

Similar advantages would arise from a partial specialisation of the angular measurements. Thus the first-class observer with a theodolite must possess certain qualities of eyesight, health, and judgment, rarely combined in one individual. When such a combination of qualities is found, it should be made the best use of, and a good man should not be wasted on second-class work. At present upon the system of regarding each colony as an isolated unit, it is not possible to employ every man to the highest advantage, and there are doubtless many examples at present in Africa of able men being set tasks much below the standard of their ability, and, *per contra*, men of no such qualifications being given work beyond their powers. It is only by working with an extended organisation, employing a large staff and responsible for a large area of country, that any approximation can be made towards that ideal wherein every member of the establishment is used to the best advantage according to his special qualifications.

To turn from the triangulation to the question of topography, we shall find analogous arguments in favour of entrusting this work to one central department. Whether we consider the necessity for a uniform system of training for the topographer, or whether, looking at the matter from the other side, we consider the desirability of a close degree of uniformity in the resulting map, we arrive at the same end. Nor need we confine ourselves to theoretical arguments; practical results

are before us as examples. It is not possible at the present moment to point out a single case of a thoroughly satisfactory topographical map of any country whatever which has not been executed by men trained in a properly organised survey department or, what is equivalent, in the Corps of Royal Engineers. Examples of failure to accomplish this are numerous. Thus we have the cases of the British Colonies in South Africa before the war; of Canada, where no topographical map existed until two years ago, when the work was taken up by the military department; and of Ceylon, where, in spite of the vast sums spent on survey and the small size of the island, no topographical map of the slightest pretensions to completeness exists of any part of the country.

It may also be noted that, especially in the case of a developing country, it is of enormous advantage that the map shall be begun and finished within some reasonable time. If a long interval elapses between the commencement and the completion, the first sheets are out of date before the last are done, and the whole exhibits a most undesirable lack of uniformity.

With a central organisation the mapping of each protectorate can be taken up in turn and dealt with rapidly, thus producing a homogeneous map impossible to a small local body. Upon the converse point, the question as to whether our central department should or should not undertake cadastral survey, the arguments are perhaps not so one-sided. It is, however, quite clear towards which side the balance of advantage tends. Taking into account the intimate connection of the cadastral survey with the system of land holding and land taxation, the fact that these systems necessarily vary and that as a financial matter of account the receipts and expenditure of each colony are separate, it is not difficult to see that the land survey is better left to local control. This would not preclude any particular colony from arranging with the central body for the execution of any definite piece of work of this class, upon terms agreeable to both sides, in a similar manner to that in which cadastral survey is executed by the Indian survey for provincial Governments, and it need hardly be pointed out that the geodetic points fixed by triangulation would in any case be available as a framework for the large-scale map.

The geographical survey of the British Empire, apart from Africa, will not on this occasion detain us long. I exclude from present consideration the great self-governing colonies—Canada, Australia, and New Zealand—and also the whole country lying within the sphere of the survey of India. Ceylon has an elaborate land survey system; and though, owing to past mistakes, the geographical mapping of the island is in a most lamentably backward condition, there are good grounds for hope that this state of affairs will be remedied in the near future. The Malay States, where, owing to the fertility of the soil and the ubiquity of rich tin ore, the land values are high, have the basis of an excellent survey system, and possess a backbone of triangulation which will eventually extend southward to Singapore, and possibly northward to join the Indian series in the south of Burma. Hongkong, including the leased territory on the mainland, is of small area and of no appre-

ciable geographical importance. It has been adequately mapped for military purposes. Of our insular possessions, Mauritius, St. Helena, and (in the Mediterranean) Cyprus and Malta are thoroughly surveyed. The other islands scattered throughout the ocean which fly the Union Jack, including the West Indies, while their coast-lines have naturally been the subject of close attention by the Hydrographic Department of the Admiralty, are, as regards their internal geographical features, still quite imperfectly known. The large and important territory of British Guiana is entirely unsurveyed, and indeed in part almost unexplored.

You will thus realise that if we are prepared to admit the validity of the premiss that the mapping of its own territory is an imperative duty of a State which aspires to justify itself before the nations as the possessor of a world-wide Empire, there is still plenty of employment for the scientific geographer in the British dominions.

Having thus far spoken of our duties and obligations, for such they appear to me, which lie abroad in countries remote from our own shores, let us now turn our eyes inward and see if we cannot discern some similar duties lying close to our hands.

I take it that the great majority of us have been brought up in the idea that our own Ordnance Survey is of such a high order of accuracy that a proposal to undertake a revision of the fundamental triangulation of the British Isles must appear strange. Yet this idea will not be a new one to the British Association, for two years ago at the York meeting I brought the subject before this Section in a short note, which gave rise to a useful discussion.

What I shall say now will be in a large measure a repetition of my previous remarks, a repetition for which I need offer no apology, as it will be apparent to you that had any steps been taken to remove this standing reproach to British geodetical science, no recurrence on the subject would be called for. As matters stand, however, I feel impelled to recur to it with increased emphasis, a position in which I am confident of being supported by all those who earnestly care for the scientific repute of our country. Some few years ago, at the request of the International Geodetic Conference, a volume was prepared by General Ferrero, the eminent Italian geodesist, giving a summarised account of all the geodetic surveys of the world. If we take this volume and examine the relative degree of precision of the different national surveys there enumerated we shall find that Great Britain stands lowest on the list.

The popular illusion, for it is really no other, as to the extreme accuracy of the triangulation of the British Isles rests in no small degree upon what must be considered a fortuitous circumstance—namely, the accidental smallness of the closing error. Have we not all been told how at the conclusion of the triangulation, when the observations had been carried from the primary base on the shore of Loch Foyle across part of Ireland and across Wales and England, terminating in two points on Salisbury Plain, the distance between these points was calculated, using as data the measured length of the Loch Foyle base and the observed angles of the triangles across the country? The distance

between the same two points was then measured with every refinement of accuracy, and the measured length compared with the calculated length. The difference between them was found to be twenty inches. If in traversing a large portion of the kingdom the aggregate error only amounted to this minute quantity—minute, that is, compared with the distances involved—how can we either expect or demand a better result, even if the work be redone with the most refined methods that the accumulated experience of the last fifty years can suggest?

To answer this question we must bear in mind that the closing error of a piece of work such as a triangulation is not the only, nor indeed the best, test of its precision. A small closing error may be due to accident; larger discrepancies may have occurred at intermediate stages which have chanced nearly to cancel themselves at the end. Such undoubtedly did happen in this case. The work was not as accurate as the smallness of the closing error would seem at first sight to imply. We have, however, in such a case an absolute measure of relative precision in the magnitude of the average triangular error, being the quantity by which the sum of the observed angles of a triangle exceeds or falls short of the true value of 180° + spherical excess.

From this we can readily deduce the "probable error" of a single observed angle, a form in which the measure of precision of a triangulation is often expressed.

In our British survey this quantity equals 1·20 second of arc, while in good modern work it does not in general exceed 0·25 second. Making due allowance for the fact that the network of triangles over our islands is a complicated one, and therefore that the ultimate precision is considerably greater than that of a chain of triangles of the same order of individual accuracy, we are probably justified in concluding that a resurvey would at least halve the final errors.

Such a resurvey is urgently demanded in the interests of international geodesy.

It will of course be clearly understood that this implies no adverse criticism upon the work of the men who originated and carried out the primary triangulation of the British Isles. For that great achievement we must all have the most sincere admiration. It was pioneer work of the highest order; it set a standard of accuracy never before attained, and was for long taken as the model for such work in other countries. It was, however, started at the end of the eighteenth century and was completed in 1857. It is therefore hardly surprising that it falls somewhat short of the precision of modern observations of the same class. It will also be understood that this resurvey does not affect the question of the reliability of our Ordnance Survey maps. Any errors which exist in our triangulations are important only for geodetic discussions, such as the determination of the exact figure of the earth, and are quite negligible for map-making purposes. There can be no appreciable error from this cause upon the maps of our own country, even those on the largest scales, and no question of reconstructing our maps can arise. This is fortunate from the financial point of view. Such a reconstruction would involve a very heavy expenditure, while the cost of the retriangulation

suggested would be quite trifling compared with the actual annual expense of our national surveys.

The result of this inferiority in accuracy of the British survey is that it is useless to co-ordinate it with the continental series for geodetical purposes. This defect is all the more noticeable in that the necessary observations for joining up the two series were actually made. Three stations on the coast of Kent—St. Peter's Church, between Margate and Ramsgate; Coldham, a hill about two miles north of Folkestone; and Fairlight, a hill about four miles north-east of Hastings—were connected trigonometrically with three stations in France — Montlambert, near Boulogne; St. Inglevert, over the village of Wissant; and the Clock Tower at Gravelines. This was done in 1861–63. The observations were of a high order of precision. It would not be necessary to repeat them.

The importance of the co-ordination is apparent when we inspect a map of Europe with the neighbouring part of Africa, upon which the triangulation lines are entered. We then see that the British part of the work is imperatively required to extend, and in fact to complete at one end in each case, two important geodetic arcs, viz., the meridional arc along the meridian of Greenwich and the longitudinal arc along the latitude of 52° north. Without the British portions these arcs extend from Ain Sefra in Algeria to Gravelines in France, an amplitude of 18°, and from Orsk in Russia to the same point in France, an amplitude of 57°. With the British section added they would be further extended to Saxavord, the northernmost point of the Shetland Islands, and to Valentia, on the West of Ireland, respectively. The added amplitudes would be 10° and 11½°, very material additions, which would undoubtedly prove of substantial scientific value.

It will thus be seen that it is by no means necessary, or even desirable, to re-observe the whole network of triangles covering our islands. All that is required is to connect geodetically the three extreme points—Saxavord, Valentia, and the stations on the Kent coast just mentioned.

A knowledge of the exact figure of the earth is of high scientific importance, especially so in reference to recent speculations as to its possible deviation from a spheroidal form. It cannot be other than a subject of national shame that so important a link in this research remains unfilled. We may note with gratification the forward position that our nation has in the past taken in the advancement of geodesy. We know the great work done in the triangulation of India, and we have alluded to the magnificent conception of the Cape to North Sea arc due to Sir David Gill. Surely it is not asking too much that we should take steps to set our own house in order, and to ensure that our own triangulation is at least as accurate as that covering the neighbouring portions of the continent of Europe. The subject is one upon which the powerful influence of the British Association might legitimately be brought to bear, and any representations from our body would come with a peculiar appropriateness from this the Dublin meeting, seeing that so large a section of the work, whose importance we wish to urge upon the Government, lies upon Irish soil, whose execution would therefore devolve naturally on the Ordnance Survey of Ireland.

In concluding this address I feel constrained to apologise for what may have appeared to some of you the dull and unromantic character of my theme. I am too well aware that to many the idea of geographical advance is confined to the perilous traversing of virgin lands, to the navigation of unknown waters, and to the penetration of forests or deserts never yet trod by white men's feet. I am conscious that the substitution of the surveyor for the explorer has necessarily destroyed much of the old romance, and that the feelings born when any fraction of the earth's surface was for the first time opened to our ken can never be revived. While, however, the romance has gone the dangers remain, and there is as much call now for unflinching courage and for unselfish devotion to duty as there was in the days when the search for the sources of the Nile was an impelling cause sending adventurous men into the unknown. Whether occupied in cutting his way through the almost impenetrable forests of the Gold Coast, or struggling with the papyrus swamps of the Nile basin, or whether, standing upon the top of some old volcanic hill, he is engaged in scanning the blue distances of the great Rift valley, the surveyor is not less worthy of your admiration than the earlier traveller whose name is perhaps honourably enshrined in that of river or mountain. Whether pushing his way through the jungles of the Malays or floating upon the muddy stream of an African river, whether he is braving the attacks of savage animals, of treacherous natives, or the far more insidious assaults of the germs of some deadly disease, he is equally deserving of your sympathy and your encouragement. He is in truth a shining example of the power of that spirit of adventure and thirst for information which has carried our race so far in the past, and which in the future is, we all trust, destined to lead us ever "upwards and on": the spirit that esteems no sacrifice too great in the cause of duty, and recognises no duty so high as that of making some contribution towards the increase of natural knowledge.

THE NINTH INTERNATIONAL GEOGRAPHICAL CONGRESS.

The Ninth International Geographical Congress was held at the beautiful city of Geneva, under the presidency of M. Arthur de Claparède, from July 27 till August 6, and must be regarded as having been a great success, and as having done much to further the interests of geography. It was attended by a very large number of delegates from Governments, Universities, geographical societies and other bodies, and had on its roll about 740 members, of whom some 160 were delegates. Some of those whose names were on the list did not appear at Geneva, and others did not stay for the whole period of the Congress, but the members were sufficiently numerous to ensure that both the general meetings and the sections were for the most part well attended.

The meetings were held at the University, with the exception of two sections which found accommodation at the neighbouring building of the Athénée. The general meetings were held in the large hall or

Aula, and the sectional meetings for the most part in the various class-rooms. In the University also the secretary and other officials had their offices, and the Congress was thus fortunate in being housed in a building which permitted practically everything to be carried on under the same roof. The beautiful garden also which surrounds the University buildings added much to the pleasure of the "congressistes." For the use of the University buildings the Congress was indebted to the Department of Public Education in Geneva, and especially to its President, M. Rosier.

The duties of the day included a morning meeting, beginning at the early hour of nine, and an afternoon session which began at two and often lasted till 4.30 or later. The late afternoon and evenings were usually given up to fêtes and receptions, so that the day was well filled up. Apparently, however, the hour of nine proved too early for those of the members who were not accustomed to Continental ways, and whether in deference to their prejudices or from other causes, it was noticeable that the stated time of opening, both of the morning and afternoon sessions, speedily came to represent an ideal rather than an actual condition.

Throughout the Congress the meetings were so arranged that the mornings were taken up by a general assembly in the Aula, and the afternoons by the meetings of the fourteen sections. The latter, however, did not all meet on the same day, the arrangement being that the even numbers meet one day and the odd the next. The fourteen sections were as follows:—

I. Mathematical Geography and Cartography. President, Lieut.-Col. Held, Berne; Secretary, René Sabot, Geneva.

II. General Physical Geography. President, Professor A. Penck, Berlin; Secretary, Ch. Schöndelmayer, Geneva.

III. Vulcanology and Seismology. President, Dr. Johnston-Lavis, Beaulieu; Secretary, Dr. Léon Collet.

IV. Glaciers. President, Professor Jean Brunhes, Fribourg; Secretary, André Chaix, Geneva.

V. Hydrography (Potomography and Limnology). President, Professor F. A. Forel, Morges; Secretary, Dr. M. A. Boubier, Geneva.

VI. Oceanography. President, Dr. Otto Krümmel, Kiel (who replaced Sir John Murray, originally chosen as President); Secretary, Dr. Léon Collet, Geneva.

VII. Meteorology and Climatology.—Terrestrial Magnetism. President, Professor Hellmann, Berlin; Secretary, Dr. Alfred de Quervain, Zürich.

VIII. Biological Geography (Botanical Geography and Zoogeography). President, Dr. Casimir de Candolle, Geneva; Secretary, Dr. Hochreutiner, Geneva.

IX. Anthropology and Ethnography. President, Professor O. Lenz, Prague (who replaced Professor E. T. Hamy, Paris); Secretary, Dr. André de Maday, Geneva.

X. Economic and Social Geography. President, Professor Eug. Oberhummer, Vienna; Secretary, Édouard de Faye, Geneva.

XI. Exploration. President, Professor O. de Nordenskjöld, Gothenburg; Secretary, Édouard de Faye, Geneva.

XII. Teaching of Geography. President, Professor W. M. Davis, Cambridge, Mass.; Secretary, René Sabot, Geneva.

XIII. Historical Geography. President, Professor Henri Cordier, Paris; Secretary, Dr. Arthur Sautter, Geneva.

XIV. Rules and Nomenclature. President, Commandant Roncagli, Rome; Secretary, René de Saussure, Geneva.

As to language, it was noticeable that French, as was to be expected, largely predominated. German was also frequent, while English was less so, speeches or statements made in that language being frequently translated into French by the speaker or by the President after delivery. Italian was rare, the Italian delegates, like the Portuguese, usually speaking in French.

As to the details of the arrangements of the work of the Congress, those must always be difficult in the case of an International Congress where the members are separated from each other and from the organising committee, until the actual opening of the meeting, by great distances. In the present case the effect of this separation was especially discernible in the earlier meetings, where of a long list of proposed communications in particular sections only one or two were perhaps available in the absence of the authors. A considerable number, indeed, of the papers which appeared in the general programme were not read at all, certain of the authors who were unable to be present having apparently either not sent their communications or made no special arrangements to have these read. In future congresses it would be well if the organising committee could furnish the authors at an early date with an approximate idea as to when their communications are likely to be read, so that if they are unable to be present at the opening meetings they may make arrangements in regard to their papers. Another difficulty, which arose out of the fact that the sections only met on alternate days, was that the officials of any particular section were difficult to find on the intervening days for the purpose of making arrangements, and from this fact various minor difficulties resulted, such as that authors were sometimes put down for papers in two sections at the same time. It would also have been a great convenience if, as is sometimes done at the British Association, the daily programme had contained a list of the papers read the previous day. This was, however, to a considerable extent made up for by the excellent reports which appeared daily in the *Journal de Genève*, which was sent free to all the members of the Congress. For these reports, and for the daily copies of the paper, the sincere thanks of the members are certainly due.

The general meetings in the mornings were for the most part excellent, and had the great advantage of bringing together all the members of the different sections, which permitted of that free inter-

change of ideas which is the great attraction of such a Congress. It was felt, however, that the number of these general meetings was rather great, and the restriction of the sectional meetings to the afternoons prolonged the Congress somewhat unnecessarily. It was not also always clear what differentiated a general meeting from a sectional one, several papers which were down for sections being later transferred to the morning assemblies. Further, some of the papers in these general assemblies gave rise to interesting discussions, which were postponed to the sectional meetings on account of want of time. This was a disadvantage in that the greater number of those who had heard the morning paper naturally wished to follow the discussion upon it, and as the section in which this took place was held simultaneously with a number of other sections, the attendance at the latter suffered considerably. It would seem preferable to regard both paper and discussion from the same point of view. If the one was of general interest, the other should also have been so regarded, and *vice versa*.

Some account of the proceedings of the Congress may now be given. Prior to the formal opening on Monday, an informal reception was held at the Palais Eynard the previous evening, when the members of the Congress were welcomed to the town of Geneva by the Administrative Council (Municipality). On Monday the first meeting was held at nine o'clock in the Aula of the University. The proceedings were opened by M. Ernest Brenner, President of the Swiss Confederation, and Honorary President of the Congress, who gave a cordial welcome to the members of the Congress, and went on to speak of what Switzerland has done and is doing for geography. He stated that the association of the heads of the cantonal departments of education are now occupied, with the support of the Confederation, in compiling a geographical atlas for secondary schools, and this will be followed by another, destined for primary schools. In addition to the existing departments which relate to geographical science, the Confederation has just created a bureau of hydrography, whose object is to make a survey and an exact chart of the *régime* of all the Swiss streams.

M. Brenner was followed by M. Henri Fazy, President of the State Council of the Republic and Canton of Geneva, and Honorary President of the Congress, and by M. Arthur de Claparède, President of the Geographical Society of Geneva and of the Congress. M. de Claparède, after conveying the thanks of the Congress to all those whose aid had facilitated the work of the Organising Committee, gave a short account of the eight previous International Geographical Congresses. The first was held at Antwerp in 1871 under the presidency of Charles d'Hane Steenhuyse, the second at Paris in 1875 under the presidency of Admiral de la Roncière le Noury. Seven years passed between this and the third Congress, held at Venice in 1881, when the Duke de Sermoneta presided, while eight years intervened between the third and the fourth Congress held at Paris in 1889. This was presided over by Ferdinand de Lesseps, then at the height of his reputation. Two years afterwards, in 1891, the fifth Congress was held at Berne under the presidency of Councillor Albert Gobat, who was also present at the

opening meeting of the ninth Congress. The sixth Congress, that of London in 1895, was presided over by Sir Clements Markham, while the seventh, held at Berlin in 1899, had for its president the much-lamented Ferdinand de Richthofen, one of the glories of contemporary German science. Finally, the last and eighth Congress, held in the United States in 1904, which met successively at Washington, New York, Niagara, Chicago and St. Louis, was presided over by Commander Robert Peary. M. de Claparède closed in expressing the hope that the ninth Congress might sustain comparison with its predecessors, and like them be fruitful to science and useful to humanity.

Captain Cagni then said a few words in the name of the State delegates, Professor Gerland spoke in the name of the Universities represented, and Prince Roland Bonaparte on behalf of the oldest of the geographical societies, that of Paris. The last speaker in this the more formal part of the proceedings was Professor Davis of Harvard, who thanked the Organising Committee in the name of the other institutions and societies represented.

The scientific proceedings opened with a communication by M. Alexandre Moret, of the Musée Guimet at Paris, who spoke on the journey round Africa accomplished by the Egyptians under Néchao II. ("Le Périple de l'Afrique accompli par des Égyptiens sous Néchao II."). It will be recollected that Herodotus gives an account of this voyage, which he states lasted three years, but whose occurrence has been generally doubted by geographers. M. Moret has found in the collection of the late M. Burian a stone scarab ornamented with hieroglyphics which gives an account of this journey, and this account is confirmed and supplemented by another scarab, belonging to the same collection, but found in the Brussels Museum. A somewhat animated discussion followed the reading of this paper, the authenticity of the scarabs being supported by M. Édouard Naville and doubted by Professor Oberhummer, as also by two Portuguese delegates, M. Vasconellos and Col. du Bocage, who showed themselves zealous for the honour of Vasco da Gama. It may be noted that further examination by experts seems to justify the scepticism expressed at the Congress.

At the close of the meeting the inevitable photograph of the members of the Congress was taken.

The afternoon was given up to the meetings of the sections of odd numbers (I. II. III. V. VII. IX. XI. XIII.). For the reasons given above several of these sectional meetings proved very short.

In I. (Mathematical Geography and Cartography) Captain Lyons, of Cairo, discussed the survey of Egypt and displayed some representative maps. We are glad to learn that Captain Lyons is shortly to publish a book on the subject, and on the publication of this we hope to treat the matter more fully.

M. Ch. Lallemand then read an interesting report by M. Ernest Nicolle (cf. below) on the meridian of Greenwich in relation to time ("La Question du méridien de Greenwich comme base des fuseaux horaires, spécialement envisagée au point de vue de la France.") He was followed by General de Schokalsky, who discussed the question of methods of

measuring the length of the rivers of Russia in Asia, and also the general question of measuring curved lines on maps.

The secretary then read a report by M. Perron on the reproduction in facsimile of ancient geographical monuments, and of its use in the formation of cartographic museums. A committee was appointed to consider this question during the meeting of the Congress. This was followed by a paper by M. Eginitis, of Athens, which discussed the determination of the latitude and longitude of Athens, and expressed the desire that an international understanding might be come to whereby the time and longitude determinations might be transmitted by wireless telegraphy.

In Section III. (Vulcanology) the president, Dr. Johnston-Lavis, opened the proceedings by the reading of a paper on the mechanism of volcanic activity, which was followed by a discussion. This was followed by papers by Professor Rudolph of Strasburg and Professor Hobbs of Michigan, who spoke respectively on the relations between the tectonic and seismic conditions in Eastern Asia, and on the damage caused to bridges by earthquakes.

In Section V. (Hydrography) the president, Professor Forel, spoke on the question of the origin of the fishes of the Lake of Geneva. . The relative poverty of the lake in species (19 out of some 40 Swiss species) is remarkable, and the question how the lake received its fauna is also of interest. It seems probable that in the post-glacial period there was a communication between the lake of Neuchâtel and that of Geneva by a stream of water which probably flowed from the north to the south.

In Section VII. (Meteorology) various reports were presented. Thus M. Maurer, the director of the Central Meteorological Institute of Zürich, presented the new rainfall map of Switzerland, which completes that of the late M. Bilviller, published in 1893. A report was also presented on a work published by the Geographical Society of Portugal, entitled *Elements of Nautical Meteorology*. Dr. Polis of Aix-la-Chapelle spoke of weather-forecasting and of the telegrams which vessels crossing the oceans might dispatch to Europe. The president, Professor Hellmann, gave a masterly exposition of a new method of determining the average rainfall of a district.

In Section IX. (Anthropology and Ethnography) the meeting was given up to a lecture by Professor Lenz, the president, on the Jews of Abyssinia and Morocco. In Abyssinia the Jews call themselves Talachas, and number about 20,000 to 30,000, while in Morocco, where they number 150,000, they bear the name of Hispanioles. The reading of the paper was followed by a discussion.

In Section XI. (Exploration), after a few words of introduction by the president, Dr. Nordenskjöld, M. Lecointe, scientific director of the Royal Observatory of Belgium, gave an account of the International Polar Institute, founded at Brussels in 1907 with the following objects:—

"(*a*) To form a special library which shall contain all printed books and manuscripts relating to polar regions; (*b*) to establish an iconographical collection which shall include, classified by subjects, all maps,

photogrammes, photogravures, etc., bearing upon polar regions; (*c*) to make a complete polar bibliography; (*d*) to elaborate a systematic encyclopædia (with references), which shall condense and co-ordinate, within the framework of its classification, all results obtained and cited in published documents; (*e*) to promote the appearance and regular publication of an *International Polar Review*; (*f*) to organise a permanent polar museum.

"The permanent staff of this Institute consists at present of M. Lecointe, scientific director of the Royal Observatory of Belgium, second in command of the First Belgian Antarctic Expedition and secretary of the Provisional Committee of the International Polar Commission, who is provisionally acting as director of the Institute; M. Denucé, doctor of philosophy and literature; M. Vincent, doctor of science. M. Dobrowolski, member of the scientific staff of the *Belgica*, was attached to the staff of the Institute during the two months which preceded his return to Russia, and M. Arctowski, member of the scientific staff of the *Belgica*, has kindly given us his assistance since the month of March 1908."

Captain Harfeld, Brussels, then gave an account of his recent explorations in the Honan region of Southern China, where he constructed numerous topographical maps, some of which he showed. He found that some of the rivers had a breadth of 400 to 600 metres. This paper was followed by one by Baron Hulot of Paris, who gave an account of recent French exploration in Africa, in Algiers, Tunis, French West Africa, and the French Congo.

In Section XIII. (Historical Geography) the vexed question of priority gave rise in one instance to an animated discussion. His Excellency de Oliveira Linia, Minister of Brazil at Brussels, gave an account of the diplomatic negotiations which his country has carried on with neighbouring states in connection with the fixation of frontiers. Don Alfredo Gumma y Marti claimed for the Spaniards the priority in the discovery of Korea, some of his claims being questioned by the president. Professor Niermeyer gave an account of the recent Dutch explorations in New Guinea, when Dr. Lorens and Captain Goosseus demonstrated the existence of snow mountains in this torrid climate.

Finally, M. Edouard Naville read a very complete memoir on the commercial relations between Ancient Egypt and its neighbours.

The second general meeting, held on Tuesday, July 28, began with a paper by M. Rosier, of the State Council, who spoke on the scope of geography considered as a teaching subject. M. Rosier began by saying that, in spite of the improvements which have been effected, geography does not yet occupy the position which it ought to occupy either in primary or secondary education. He regards it as unnecessary to seek to define geography considered as a subject for research, but from the teacher's point of view it must be regarded as comprising three elements, the reading of maps, the scientific description of the earth, and the study of the relation between the inorganic world and the living beings upon it. Of these the reading of maps is the peculiar domain of geographers, and it is nevertheless the least emphasised part in teach-

ing. It should be commenced in the primary school, and the fact that the beautiful wall-map of Switzerland is distributed free to all the schools of the Confederation should greatly facilitate the task. M. Rosier concluded a very eloquent address by the following resolution, which, as will be seen below, was discussed later in the teaching section:—

"Geography, considered as a teaching subject, has for object the reading of maps and the scientific description of the earth, that is to say of the diverse elements, physical and animate, whose combination and relation determine the actual physiognomy of the globe. It is divided into Mathematical Geography, Physical Geography, Biological Geography, and Human Geography, the last being again divided into Historical, Political, and Economic Geography. Its peculiar province is the study of the relations between the inorganic world and living beings, and more especially between the earth and man."

M. Rosier was followed by Professor Charles Flahault of Montpellier, who spoke of the duty of botanists in regard to human geography. This paper we hope to present here at a later date in translation.

Professor Oberhummer of Vienna then spoke on the relation of Leonardo da Vinci to Geography, and stated that he regarded the period of the Renaissance, especially as illustrated in the writings of Leonardo, as one of the most important for geography. Leonardo constructed several orthographic maps, published by Richter, mostly of Italy, but also of France, the East, etc. These are especially hydrographical maps, Leonardo regarding river systems as analogous to the circulation of the blood in the veins of man. On the question of origins he already held modern views. On the other hand he regarded sea-level as the exact mean between the ocean depths and the mountain heights. His estimates of mountain heights were relatively exact, and his theory of volcanoes was plausible. Professor Oberhummer believes that his influence on his epoch was very great, Dürer, for example, being both an engraver and a publisher of maps.

Professor Penck then presented a report on the state of advancement of the 1 to 1,000,000 map of the earth. The discussion lead to the formulation of a resolution which came up at a later meeting of the Congress (see below).

In the afternoon all the sections of even numbers met with the exception of XIV. (Rules and Nomenclature) which was obliged to adjourn for want of an audience.

In Section II. (General Physical Geography) Dr. Eug. Romer of Lemberg spoke of certain river terraces in the Carpathians in relation to glacial phenomena, and was followed by M. Sederholm, Helsingfors, whose communication treated of the geomorphology of Finland. Finland, according to this author, must be considered as an ancient peneplain, which was scoured by glaciers at the period of glacial extension, hence the extreme richness of the country in lakes and coastal islets.

Professor Martonne, Lyon, then spoke on the systematic position of

the chain of the Carpathians, his paper being followed by a discussion as to the question whether it is possible to establish certain general types of relief.

In Section IV. (Glaciers) M. Jacob spoke of the surveys and measurements of length of glaciers carried on in the massif of Pelvoux by the scientific committee of the Ministry of Agriculture at public expense, and the utility of such observations was emphasised by other speakers. Some other papers on glacial questions followed, but these tended to approach the geological aspects of the subject more closely than the geographical.

In Section VI. (Oceanography) Professor Pettersson gave an interesting summary of the work of the International Council for the Study of the Sea, presenting at the same time the reports of the Council. He further spoke of the importance, alike from the physical and biological standpoint, of an international exploration of the Atlantic Ocean. He was followed by Admiral Chester, who spoke on the physical geography of the sea.

In Section VIII. (Biological Geography) M. Descombes spoke on the question of the over-pasturing of mountains and the necessity for the afforestation of areas on a steep slope, his paper being followed by an interesting discussion. A technical paper by M. Jaccard of Zürich on the distribution of plant species was followed by one by Professor Tanfilief of Odessa on the influence of soil temperature as distinguished from air temperature in determining the distribution of plant species, especially in connection with the trees forming the forests of Russia.

In Section X. (Social and Economic Geography) Professor Vidal de la Blache of Paris spoke on the geographical interpretation of landscape, showing how climate, slope, relief, etc., determine the position of dwellings and of crops, the distribution of population and so on. He was followed by M. Max Alffthan of Helsingfors, who read a paper on the social and economic condition of Finland, illustrated by plates from a new edition of the Atlas of Finland which is about to appear.

Dr. Day of Washington then read a paper on the petroleum deposits of the world, the output of which continues to increase, 28,000,000 tons being supplied by the United States last year alone. Many of the ancient beds being exhausted, the new deposits of Wyoming and Oklahoma are now being exploited, but in a highly wasteful fashion. Professor Perry Brigham of New York discussed the factors which determine the distribution of population in the United States. He calculates that the Mississippi valley alone is capable of supporting 250,000,000 human beings, or four times the actual population of the entire States.

Professor Clerget of Lyon followed with a paper on the navigation of the Rhone, the possibility of improvements, and its commercial importance as regards the relations between the east of France and Geneva.

In Section XII. (Teaching) Dr. Hotz-Linden exhibited specimens of the beautiful wall-maps of Switzerland used in the schools of that country, and discussed the merits of the different types. In this con-

nection it may be noted that the relief of Switzerland which was exhibited at the last Paris Exhibition now stands in the entrance-hall of the University of Geneva and attracted much attention during the Congress. Reproductions of this as a wall-map are also available, and specimens on various scales were exhibited in the room where the meetings of Section XII. were held. Many of the foreign delegates commented on the great assistance in the teaching of geography in Switzerland given in the first instance by the striking relief of that country, and secondly by the many beautiful types of representation available. If Scotland contains no such lofty mountains nor such deeply-incised valleys, yet even here there are sufficient irregularities of surface to make it possible to supply schools with more vivid wall-maps than are at present to be found there.

Dr. Silva Telles of Lisbon then read a paper on the teaching of Advanced Geography, copies of this paper being available to the audience in French at the time when it was read, a precedent which might have been much more widely followed. If the printing of the whole paper in similar cases be not possible, it is certainly eminently desirable that an abstract be supplied, as at the British Association. In the case of the more technical papers the want of such abstracts was often severely felt, for it must be remembered that not only were all the papers delivered in a language which was necessarily a foreign one to some members of the audience, but further, owing to the predominance of the three languages named above, many papers were read in a language which was a foreign one to the author, and this often considerably increased the difficulty of comprehension. Dr. Silva Telles' paper followed much the same lines as that of a subsequent discussion on the teaching of geography (see below). Later Professor Hobbs read a paper which we shall publish here later.

The general meeting of Wednesday, July 29, was devoted to theories of Alpine Glaciation, a subject which, as was only natural under the geographical conditions, absorbed much of the attention of the Congress, though it is to be noted that both papers and discussions tended to reduce the distinction between geology and geography to a vanishing-point.

Professor Penck of Berlin opened the proceedings by a paper on the climate of the Ice-Age, in which he expressed the opinion that during that period there was no excessive fall of snow but merely a lowering of temperature, which diminished melting. The level of the névés was not raised, but the glaciers extended much further over the low ground, so that the Glacial Period extension was observable only at their lower extremities. An interesting discussion followed in which the predominance of opinion favoured Professor Penck's view.

Professor Brunhes of Fribourg then delivered a lecture, illustrated by lantern views, on his theory of glacial erosion, a theory which we have already fully discussed here. The discussion on the paper was remitted to the section of Glaciers. The morning session closed with a paper read on behalf of M. Vallot, of the Mont Blanc Observatory, which summarised the observations of the staff of the Observatory on the varia-

tions of the Mer de Glace. The conclusions reached are that as regards this glacier the effect of the Glacial Period has been exaggerated.

In the afternoon in Section I. a number of technical papers were read. The one of most general interest was that by M. von Ziegler on his ingenious mechanical perspector. This instrument was also exhibited to the members of the Congress during the course of the meeting, demonstrations being given by M. Ziegler, and specimens of the results obtained being on view. We hope at a later date to give some account of this instrument here.

In Section III. the following papers were read:—Professor Gerland, Strasburg, Comparison of the Pacific and Atlantic Oceans in regard to their Seismic Relations; M. J. F. Niermeyer, The Hague, The Topographical Position of the Volcanoes of the Dutch East Indies: Professor Rudolph, Strasburg, The Great Ocean Depths from the Seismic Standpoint; Professor Platania, Stromboli. Professor Platania's paper was illustrated by cinematographic views, and it raised so much interest that it was repeated by special request on Saturday morning.

In Section V. a variety of papers were read, chiefly on detailed points in connection with European and Asiatic lakes.

In Section VII. the papers of most general interest were one on his meteorological globes (cf. this *Magazine*, p. 379), by Professor Kassner of Berlin, and one on the climatology of the Great St. Bernard by Professor Gautier of Geneva.

In Section IX. the Marquis Colocci, Catane, spoke on migration of peoples in Central Asia, his paper being followed by a discussion, and Dr. André de Maday on the relation between geography and sociology.

In the section of Exploration (XI.) a paper was read on the work of the Peary Arctic Club, and one on behalf of Dr. W. S. Bruce of Edinburgh on the Scottish Expedition to Spitsbergen. In the Historical Section (XIII.) several papers were read and reports presented.

The following day (Thursday) was reserved as a day of repose very welcome to the members of the Congress after the heat of the previous days. It was devoted to a tour of the lake, a tour which was in all respects successful. Most of the members spent it in the enjoyment of the splended scenery and of the social intercourse which the large and comfortable steamers permitted, but some zealous spirits held formal or informal committee meetings, or studied special points in connection with the lake. Very interesting were two short addresses delivered by Professor Forel of Geneva on one of the boats, one in connection with the entrance of the turbid Rhone into the blue lake and the other on the colour of the lake. The former was delivered while the boat remained stationary close to the entrance of the river, and Professor Forel explained how the icy waters, heavy both because of their temperature and because of their weight of alluvium, plunge downward to the depths of the lake in a continuous cascade, and also how in spite of their chill they are actually a source of warmth to the lake, for they are less cold than the bottom layer of water which they displace. It is this action which prevents the lake growing constantly colder, as it otherwise would in view of the fact that the Rhone when

it leaves is much warmer than when it enters. The sharp line of demarcation between the turbid Rhone and the blue lake water was very beautifully seen owing to the course taken by the steamer, so that Professor Forel's address was delivered under almost ideal conditions.

With Friday the serious work of the Congress recommenced, and it is to be feared that even Thursday's holiday hardly reconciled the English-speaking delegates to such a breach of tradition as the holding of meetings both in the morning and the afternoon of the following day. It was at least noticeable that their number began to diminish rapidly thereafter.

Friday morning was announced as to be devoted to the Conquest of the North Pole, but was in some respects disappointing, a sufficient number of papers on the subject not being forthcoming. Mr. Bryant read a letter from Commander Peary, whose plans we have already fully detailed here. M. J. P. Tolmatchof, of St. Petersburg, then gave an account of a proposed expedition to the peninsula Taimyr and Cape Chelyuskin, a region very insufficiently known. It is proposed that the expedition should set out in 1910 and explore first of all the interior of the country to the south-west of the peninsula. The following spring the expedition would be divided into three groups, each group being furnished with reindeer. By their aid the peninsula would be explored on the eastern side, on the western side, and in the interior by the three divisions of the party, which would reunite at the mouth of the Taimyr river, by means of which they would ascend to the tundra.

This was followed by an address by M. Georges Lecointe on the International Polar Institute (see above).

Commander Roncagli then spoke on the relation between geography and commerce, and proposed that an international bureau should be established with the object of disseminating commercial information, especially as regards new countries. This resolution came up again for discussion at a later date (see below).

In the Sections the event of the afternoon was a combined meeting between Sections II. and IV. to discuss the problem of glacial erosion. The discussion aroused a large amount of interest, and therefore greatly reduced the attendance at the other sections, who spent most of the afternoon waiting either for audiences or for their speakers, who in the fervour of discussion had lost account of time. As to the discussion, the writer of this article was unable to be present, and could obtain little definite information as to its course, save that it had been animated and had shown that the time for general agreement has not yet come.

In the other sections it may be noted that in Oceanography (VI.), Professor Vinciguerra emphasised the importance of a study of the Mediterranean in connection with fisheries; Professor Brennecke, of Hamburg, gave an account of the results of the *Planet* expedition, illustrated by limelight views, and some other papers were also read.

In Biological Geography (VIII.) Professor Chodat of Geneva spoke on the botanical Geography of Paraguay; Professor Keller of Zürich on the geographical distribution of ancient races among domestic animals, and Dr. Hochreutiner of Geneva, in speaking of the flora of

Madagascar, emphasised its affinities with that of the extreme east and of the south of Africa.

In Section X. was read a paper by Miss Owen which we shall publish here later as well as some other communications, while in XII. the value of geographical excursions in connection with school teaching, holiday courses, the teaching of geography in Belgium (cf. this *Magazine*, xxiii. p. 492), were among the subjects discussed.

In Section XIV. a report on the chief difficulties in the way of an international agreement on the spelling and pronunciation of geographical names, and the means of obviating these difficulties, was presented by Professor Ricchieri, of Milan, with the collaboration of Mr. Chisholm of Edinburgh, M. Cordier of Paris, and M. Sieger of Graz. This report, presented in Italian, was the basis of a resolution (see below); we hope to return to it here at a later date. At the same meeting a discussion, which aroused much interest, on the proper name of the Lake of Geneva, was opened by M. Roux. The section proposed that in future the names Lake Leman and Lake of Geneva should both appear on maps. This proposal came up later as a resolution of the Congress (see below).

If the North Polar meeting was in some respects a disappointment, that devoted to the Antarctic area on Saturday morning was, on the contrary, highly successful. The meeting opened with an address in German by the explorer Professor Otto von Nordenskjöld, who spoke on the work of his expedition. The paper was illustrated by lantern slides and geological maps, and summarised the chief observations and deductions made by the Swedish expedition. Though most of these have been already noticed here, it is interesting to indicate the lines followed by the paper, which was greatly appreciated by the audience. Dr. Nordenskjöld began by emphasising the relations between the part of the Antarctic area explored by the expedition and Patagonia. The former, like the latter, has a western chain of mountains, the Antarctandes, whose fossil fauna and flora, quite similar to that of Tierra del Fuego, prove that the Antarctic was once covered with plants and animals. There is thus little doubt that Western Antarctica and Southern America were once analogous countries, while to-day within 7° of the shore where humming-birds occur and men go unclad, there stretches a desert of ice, which if transported to the north would extend as far as Stockholm. This vast ice-plain seems not to cover a continent, but rather to bind together groups of islands. The ice grows with an astonishing rapidity owing to the coldness of the summers, and if the mantle of ice and snow does not extend further than it does, this is the result of the furious tempests which in some places sweep the surface bare of snow. If these tempests calmed, a formidable ice-period must ensue, and this is a possible cause of previous ice-periods. The flora of the Antarctic is naturally very meagre, and includes only about fifty species, of which some thirty are exceptional in that they do not resemble those of the Magellan Archipelago or New Georgia, but those of the Arctic region. The fauna is chiefly maritime, but includes some birds, notably the penguins.

Dr. Nordenskjöld was followed by M. J. de Frézals, Argentine delegate, who spoke of the fate of the Greenland dogs presented by the Swedish expedition to the Argentine Government. The dogs have been established on New Year Island, which has 280 days of bad weather out of the 365. In spite of the climate, however, the dogs have thriven and increased in size. On the other hand, an experiment with reindeer proved a total failure, all the animals having died at Tierra del Fuego where they were installed. The dogs are at the disposal of Antarctic explorers.

M. Henryk Arctowski then spoke on the subject of the Antarctic area in general and the results so far obtained by the various expeditions. A discussion followed, both paper and discussion serving to show how much still remains to be done in the area.

The work of the afternoon may be briefly summarised, as many of the papers were of a technical or detailed character. In Section v. Professor Woeikof of St. Petersburg, who was unfortunately not easy to follow, read several interesting papers in French, notably one on the contrast between such lakes as Chad which are areas of evaporation, and those like Baikal which from their low temperature are areas of condensation. This section had united with VII. (Meteorology), and several papers dealt directly or indirectly with climatic variations and rainfall in Asia. Some very remarkable facts came up in the course of the discussion in regard to rainfall, which showed that the theory of a general drying up of Central Asia cannot be accepted without further investigation. The facts seem also against Brückner's thirty years' cycle of rainfall.

In Section IX. an exhibition of sixteen Chinese paintings by Frau Wegener, accompanied by some observations on Chinese art, aroused great interest, while in Section XI. her husband, Dr. Georg Wegener of Berlin, gave an account, with lantern slides, of the Yangtsekiang and of his Chinese expedition.

On Monday the morning meeting opened with a paper by Lieutenant Filchner, who with his wife has made an extensive journey of exploration in Eastern Tibet and the region of the Hoang-ho. The lecture, which was copiously illustrated, was very well received, Dr. Filchner having made very extensive observations, topographical, zoological, ethnographical and meteorological.

At the close of this lecture a meeting of delegates was held to decide the difficult question of the place and date of the next Congress. Several invitations were presented, notably those from the Society of Geography at Lisbon, from the Hungarian Government and the Geographical Society of Buda-pest to that town, and from the Italian Geographical Society to Rome in 1911, on the occasion of the celebration of the fiftieth anniversary of the unity of Italy. The speeches made by the representatives charged with the presentation of these different invitations were of great interest, and a lively discussion followed. Ultimately a majority of the delegates voted for Rome in 1911, which was therefore agreed upon. The exact period will be settled later.

In the afternoon the sections of even numbers met, the chief feature being the discussion on the teaching of geography in Section XII., which was opened by M. Rosier (see above, p. 529). M. Rosier's definition of the scope and aims of geography did not meet with universal acceptance, and a considerable number of alterations and modifications were suggested by the numerous educationalists who took part in the discussion. Mr. Chisholm notably made an interesting speech in which he summarised under the following three headings the scope of geography—the study of place relations, the representation of place relations in graphic form, the study of the influence of local conditions and place relations on man.

Section II. (General Physical Geography) was largely attended, the discussion in Section XII. being closed prematurely in order to allow the members to hear a paper by Professor Davis of Harvard on certain practical exercises in physical geography. This consisted in lantern slides based upon the illustrations in a forthcoming book and intended to serve as class exercises. The other papers in this section were of a technical and often of a geological nature, with the exception of one by Professor Brunhes, who discussed methods of ensuring a more thorough practical study of topographical detail.

Section IV. held its closing meeting, where among other interesting papers read was one by M. Gautier on the relation between the oscillation of glaciers during last century and the temperature observations at the Great St. Bernard.

Of the other sections mention need only be made of X., where Professor Blondel discussed the development of Hungary, and M. César de Givenchy the economic and social evolution of Tunis, a region which has developed with great rapidity since the establishment of the protectorate a quarter of a century ago. Captain Alfred Bertrand also gave an account of his exploration, in company with Major Gibbons, of the country of the Barotsi to the north of the Zambesi.

The following morning the first subject for discussion was a proposal put forward by Messieurs Schrader and Schokalsky in regard to the formation of an International Cartographic Association and the publication of a *répertoire graphique*. This subject came up in the form of a resolution before the second meeting of delegates (see below).

Professor Penck followed with a report on the map of the world on the scale of 1 : 1,000,000. This report, like the preceding, is given in full below. It gave rise to an animated discussion, the essential points of which were embodied in the report as finally adopted by the delegates.

M. Ch. Lallemand then delivered a lecture on the Respiration of the Earth, in which he showed that very delicate observations, especially those of Professor Eckert of Potsdam, have demonstrated that the crust of the earth experiences a minute daily oscillation comparable to the tide on the sea. The lecture, which was admirably clear, was listened to with the greatest interest. The paper which followed dealt with the familiar subject of "The Scottish Loch Survey." Dr. Collet, who delivered it, gave an interesting summary of the chief results, illustrated

by lantern slides, but was unfortunately interrupted by a slight accident to the lantern.

In the afternoon only three Sections met, suggesting, as did also some of the audiences, that the Congress was somewhat unnecessarily prolonged. Dr. Scott Keltie gave in Section XIII. a short account of recent geographical progress in England. The other papers were mostly of minor interest.

On Wednesday morning Professor Blondel of Paris discussed the question of free ports, with special reference to France. He pointed out that the protectionist policy of France is unfavourable to the establishment of free ports, but he gave several instances tending to prove that this policy is opposed to the interests of French commerce. Thus the taxes on Italian and Spanish wines imposed in the supposed interest of French wine-growers have destroyed the formerly important blending trade in which these wines were required. Similar causes have destroyed the match trade, while the production of candles and soap is stationary owing to the taxes on raw materials of exotic origin. The author favoured the establishment of free ports with a neighbouring free zone in which manufactures might be carried on, but the whole paper raised questions which were not fully discussed either by the author or by subsequent speakers.

M. Porumbaru then read a paper on the work of the Danube Commission, which owed its origin to the Treaty of Paris in 1856, was renewed for twenty-one years in 1883, and has since been tacitly renewed for triennial periods. The special task of this Commission has been to render the Danube navigable down to its mouth. For this purpose choice was made of the middle arm of the river, the Sulina, which, though the smallest, proved itself best fitted for the purpose. M. Porumbaru concluded by proposing a resolution as to the prolongation of the Commission. This resolution was unanimously adopted.

The next paper was a very interesting one, by Professor Oberhummer of Vienna, on Great Cities. In the first place, the author drew attention to the fact that certain cities, such as Paris and Buda-pest, dominate the whole country in which they are placed, while other capitals do not occupy this commanding position. The paper was specially concerned with Vienna and Constantinople, and the author considered from many points of view the probable causes of their preponderance. At the close of the meeting Dr. Collet concluded the paper which had been interrupted the previous morning.

In the afternoon two Sections only met, these being II. and XIV. In the former Professor Emile Chaix of Geneva discussed a projected International Atlas of Erosion, and showed also some lantern slides illustrating the chief phenomena of erosion.

On the following morning the delegates met to discuss the various resolutions which had been proposed, either in the general or in the sectional meetings. The more important of these were printed in the three chief languages of the Congress, the others in French only. The first, and in some respects the most important, that relating to the map of the world on the scale of 1 : 1,000,000, was, like the second, that

relating to the International Cartographic Association, unanimously passed; and, in view of the importance of both, we give the official English versions in full.

The Map of the World on the Scale of 1 : 1,000,000.

At the general meeting of the Ninth Geographical Congress held at Geneva on the 27th July, 1908, the following resolution was unanimously passed :—

Resolution.

Whereas the map-making offices of several nations are engaged in compiling maps, to be published on a uniform scale of 1 : 1,000,000, under uniform agreements as to limits of sheets, etc.

Resolved that it is desirable, for manifest reasons, that a uniform set of symbols and conventional signs be adopted by all nations for use upon these maps.

Resolved that an International Committee should be formed to consider the question, and that, in order to provide a basis for the discussion, each Government and other map-producing office should be requested to supply to the Committee, within the next twelve months, specimens of the 1 : 1,000,000 maps which have been produced.

In pursuance of the terms of the above resolution the President appointed a Committee to consider the question and to make recommendations.

The Committee assembled and unanimously made the following recommendations; with the request that they should be communicated in the name of the International Congress to the Governments concerned and to the Geographical Societies represented at the Congress :

1. In accordance with the recommendation of the International Geographical Congress held in London in 1895, each sheet of the map should cover an area 4° in latitude by 6° in longitude.

The limiting meridians of the sheets should be at successive intervals, reckoning from Greenwich, of 6° ; and the limiting parallels, reckoning from the Equator, should be at successive intervals of 4°.

Each degree line should be drawn right across the sheet.

2. The Projection should, as recommended in 1895, be a Polyconic Projection, each sheet being plotted independently on its central meridian.

3. A scale of kilometres should be drawn on each sheet. An additional scale of miles may be drawn if required.

4. The heights above mean sea-level should be shown in metres : the values in feet may be added if desired.

5. Normally contours should be drawn at vertical intervals of 200 metres, reckoning from sea-level. But in very hilly districts the contours may be at larger vertical intervals, which should, however, be multiples of 200 metres. In very flat country additional contours may be inserted, provided that the intervals are even fractions of 200 metres. The colour of the contours should be brown.

Minor features which cannot be shown by contours should be shown by shading.

In addition, it is desirable that the successive altitudes should be indicated by a system of colour-tints.

A definitive scale of tints should not be decided upon until after the preparation of specimen sheets on the general lines of these recommendations.

6. Generally water should be shown in blue, but a distinction should be made between perennial and non-perennial streams. The depths of the sea and of lakes should be shown by blue contours, the vertical intervals being multiples or fractions of 200 metres. Features which cannot be shown by the contours may be shown by blue shading. The datum level in each case is to be the surface of the sea or lake. In the case of rivers, rapids, and other obstructions to navigation, are, as far as possible, to be indicated.

7. Roads and tracks should be divided into two classes,—those which are suitable for wheeled traffic, and those which are not.

8. The lettering should be in varieties of the Latin characters. A distinction should be made between the lettering applied to cultural (artificial) features and the lettering applied to natural features.

In those cases in which the Latin characters are not in use in the country in which the sheets are produced, two editions should be published ; one the national edition, and one the international.

9. A clear distinction should be made between the representations of features known to have been surveyed with sufficient accuracy to render any subsequent important alteration improbable, and the representation of those features which have been imperfectly surveyed or only roughly explored.

Proposition relating to the formation of an International Cartographic Association and relating to the publication of a répertoire graphique.

In the session of Section I. held July 29, 1908, General de Schokalsky of St. Petersburg proposed the formation of an International Cartographic Association, already proposed in the Congresses of Berlin and Washington, which should have for its principal object the collection of cartographic documents and the unification of conventional signs on maps, and other similar duties.

In the same session, M. F. Schrader of Paris exhibited a *répertoire graphique*, which indicated in a simple and distinct manner the actual progress of exploration over the world ; he showed to the Section the manner of using the *repertoire*, which can be kept up to date by the united action of geographical societies and of geographers in various countries, and proposed its adoption by the Congress as a practical aid in geographical investigation.

On the motion of Prof. Davis of Cambridge, Mass., the first Section adopted a resolution requesting the President of the Congress to name a committee chosen from among the members present at this meeting, to consider during the session of the Congress the propositions of MM. de Schokalsky and Schrader, and to report at a general session the action which the Congress should in their opinion take in these matters.

The President of the Congress having appointed the Committee, and given it the right to add to its number, the Committee designated by him has the honour to make the following recommendations :—

(1) That the proposal of M. Schrader regarding the *répertoire graphique* be adopted :

(2) That the Committee be continued as a permanent committee of the Congress with authority to take steps toward the publication of the *répertoire graphique.*

(3) That the action proposed by this Committee, together with that proposed by the Committee on the map of the world 1 : 1,000,000, shall constitute the first

and most practical steps toward the work of an International Cartographic Union.

If these three recommendations are adopted by the Congress, the Committee proposes to act in the following manner.

(*a*) To prepare a plan for the general publication of the *répertoire graphique*; to secure estimates of the cost of publication of successive editions of the *répertoire* from responsible map publishers; and thus to determine a price at which the *répertoire* can be furnished to subscribers

(*b*) To request the principal geographical societies to publish in their journals a specimen sheet of the *répertoire* as now prepared by M. Schrader and selected by the Committee, together with an explanatory text proposed by the Committee and a statement of the terms on which the *répertoire* can be furnished to subscribers.

(*c*) To proceed eventually with the publication of the *répertoire* if subscriptions are secured in sufficient number to warrant the undertaking.

(*d*) To invite collaboration in the work of maintaining the *répertoire* up to date.

The proposal by Commandant Roncagli, of the Italian Geographical Society, that an International Bureau of Commercial Geography should be established, was adopted by a majority, and an International Commission was appointed to consider details.

The resolution proposed by M. Georges Lecointe that the Congress should invite the Governments concerned to give a sympathetic reception to the proposals made to them by the International Polar Commission, was adopted without discussion. The following resolution, presented by M. Arctowski, was also accepted.

"The Ninth International Geographic Congress, realising that the only untouched fields for geographical discovery are the regions immediately surrounding the poles of the earth, desires to place on record its sense of the importance of forthwith completing the systematic exploration of the polar areas. It is very desirable that the experience gained by men of science and officers in the recent Antarctic expeditions should be turned to account by following up without delay the success they have obtained."

M. Porumbaru's resolution in regard to the Danube Commission mentioned above was also accepted.

A resolution by M. Nicolle to the effect that France should adopt the meridian of Greenwich as the basis of its time, that clocks everywhere should read from 1 to 24, from midnight to midnight, and that all clocks, including those of French railway stations, should be regulated so as to show the legal time of the country, was adopted after an animated discussion.

A proposal by General de Schokalsky, that every map should indicate its mean scale, was adopted, as also was that of M. Eginitis, Athens, to the effect that the different governments should come to an agreement with the Academy of Sciences of Paris, and the Bureau of Longitudes there in connection with the proposal to utilise wireless telegraphy for the determination of longitude (cf. this *Magazine*, p. 267). Professor Oberhummer's proposal that on plans of cities relief be represented as

on topographical maps either by contour lines or by hachures, was also accepted.

Section IV. brought forward a long resolution, also adopted by the delegates, which had for its object the improvement of methods of study of glaciers, and especially the detailed investigation of their gathering ground, the study of temperature conditions in the vicinity of glaciers, and similar subjects.

At the instance of the Oceanographical Section, two commissions were appointed, the one to further the scientific study of the Atlantic, and the other that of the Mediterranean.

M. Roux' resolution, alluded to above, to the effect that the names "Lake of Geneva" and "Lake Leman" should both appear on all maps, was also accepted by the delegates, as was that proposed in Professor Ricchieri's paper on Nomenclature (see above, p. 535), to the effect that a commission of seven members should be appointed and should be instructed to prepare a complete report on the subject for the next Congress.

A committee was also formed, at the instance of M. Olufsen of Copenhagen, with the object of promoting more intimate relations than now exist among the geographical societies of the world.

Count de Fleurieu proposed a resolution to the effect that so far as possible the names first given should be preserved on maps, and this was accepted.

The proceedings closed with two motions of a practical bearing, the one to the effect that the resolutions of the present and of future Congresses should be given as wide a publicity as possible, while the second entrusted to the Executive Committee of the ninth Congress the task of ensuring the carrying out of the resolutions of the Congress until the committee of the next Congress is constituted.

One section only, No. IX., met in the afternoon, but the Aula was again filled at four o'clock for the closing meeting. It is hardly necessary for us to summarise here the proceedings, consisting as they did of those votes of thanks and valedictory speeches which sound so much more graceful in the French language than when translated into English. A very pleasant touch was given by the speeches of welcome to the next Congress delivered by the Italian delegates, while the thanks conveyed to the President for his continuous labours no less than for his tact and courtesy had a note of profound sincerity.

The above account has omitted all mention of the lighter side of the Congress, but this does not imply that this did not exist. On all sides, by official bodies and by private individuals, invitations were showered on the members of the Congress, and all must have left Geneva with the pleasantest recollections of the hospitality of that city. Where so much was done on all hands for the pleasure and profit of the visitors it is impossible to detail all the social functions, but it would be ungracious not to offer the sincerest thanks of the delegates to the members of the Ladies Committee, and especially to Mesdames Claparède, Bertrand and Gautier, both for their graceful hospitality and for the many acts of kindness and courtesy which they found opportunity to perform for

individual members. The arrangements for all the fêtes and receptions, public and private, were admirable, and with the exception of the water fête, spoiled by an inopportune thunderstorm, all were favoured by beautiful weather, which showed the city to the greatest advantage. Among the dinners and receptions special mention should perhaps be made of the banquet to celebrate the jubilee of the Geneva Geographical Society, to which, contrary to British custom in such cases, ladies were invited, and which was distinguished by some excellent after-dinner speaking. Very delightful also were the receptions given by Captain and Madame Bertrand, and by Dr. Lucien and Madame Gautier at their respective residences.

Geneva proved itself an admirable meeting-place, and as a background to the scientific work of the Congress could hardly be improved upon. If a stranger may venture, however, to offer one suggestion, it would be that the many beautiful trees and shrubs in the *Jardin Anglais* should be named for the benefit of the foreigner from colder climes, who is bewildered by their luxuriance and variety.

Of the scientific excursions which followed the Congress it is not possible to say anything here, the reporter being of those unconscientious ones who preferred mere idling among the Alps to the zealous pursuit of knowledge on glacier or mountain summit.

THE WORK OF THE BERLIN GEOGRAPHICAL INSTITUTE.

By Grace Meiklejohn.

The geographical work of the Berlin University is carried on chiefly in the Geographical Institute. In addition to the work done there, certain lectures are delivered in the University itself, but for the purposes of this article it will be sufficient to describe the work actually carried on in the Institute.

The present Institute was founded by Baron Richthofen in 1887, and occupies the upper story of the Oceanographic Museum—a building behind the university, and within a few minutes' walk of it.

The rooms of the Institute include a moderately large lecture hall, map room, workroom, drawing-department, and library. The lecture hall is fitted up so as to make it in every way suitable for its purpose. The acoustics are good, and the room is an easy and pleasant one in which to speak. Large double windows admit abundance of light, while at the same time excluding the noise which one must expect to find around a building situated, as is the Oceanographic Museum, opposite one of the largest and busiest railway centres in Berlin. The room is well supplied with blackboards, and has also a wall relief of the Alps on a scale large enough to make it of practical value for class demonstration. Owing to an automatic arrangement the hall can be darkened at will, in order to admit of the use of a lantern when electric light views are required by the lecturer.

Opposite the lecture hall is the map room. This room is surrounded by chests containing the collection of maps. This collection—which is constantly being added to—is in every way admirable. It contains, to mention only a few, the geological survey maps of the United States, the ordnance survey maps of Britain, maps of her colonies, of India, and the sheets of Bartholomew's atlas of Scotland. One chest is used only for large wall maps, and another contains reliefs. In this room the instrument chest is kept, and in it are instruments both for field work and for map work indoors. In glass cases down the centre of the room is the morphological collection of the Institute, and in it is included Professor Penck's private collection lent by him to the students.

Opening out of the map room are two passages, one of which leads to the offices of the custodian and to the workroom. In the latter the atlases are kept. The room is provided with long tables and here the practical work, which will be described later, is largely carried on.

The library is entered from the workroom. There are at present rather less than 4000 volumes, and in addition to these the geographical pamphlets of the late Baron Richthofen—a gift by his wife to the Institute with which his name is associated. The books in the lower story of the library are arranged according to the subject with which they deal. Thus one division contains books on oceanography, another those on mathematical geography, a third those on meteorology, and so on. The upper story is devoted to works on regional geography. For example, in one division are found the standard books on India, and other lands are represented in the same way. Various periodicals are also here, and such publications as *The Geological Survey of Canada*, and *The Imperial Gazetteer of India*. In the library are small writing tables, and it is thus made possible for the students to use the books with every comfort. There is in addition a stand containing the latest numbers of the thirty-seven geographical magazines taken in by the Institute. It is unnecessary to give a complete list of these, but it may be stated that they include *The Geographical Journal*, *La Géographie*, *The Quarterly Journal of the Geological Society*, London, the *Magazine* of the Royal Scottish Geographical Society, the publications of the Japanese Earthquake Investigation Committee, magazines from Copenhagen, Stockholm, and Russia, and, of course, the leading German journals.

From the map room another passage leads to the Oceanographic Museum, and as the students can have access to this museum it gives to the work of the Institute a two-sidedness which, owing to Berlin's great distance from the sea, it might otherwise lack. The director and professors have their rooms opening off this passage, and when a difficulty arises in connection with their work students may go to them for advice or assistance. The drawing-department is also there. It is provided with paper of various kinds, drawing tables, colours, instruments for enlarging and diminishing maps, in short, all that is required where map drawing is to be carried on.

The lectures are arranged to cover a very wide field, and oceanography receives its full share of attention. In the Winter Session 1907-8 Professor Penck lectured every day on "Europe," and twice during the

week on "The Atmosphere"; during the Summer Session the subject of his daily lecture was "Mountains." Professor Grund's lectures in the winter were on "Oceanography," and in summer he gave lectures on "Applied Oceanography" as a continuation of the winter's course. In addition he held an open lecture once a week on "The Polar Regions" in winter, and on "The Balkan Peninsula and Asia Minor" in summer. The lectures, however interesting and important, by no means cover all the work done in the Institute. Map work of all kinds, such as measurement of areas and depths, determination of scale, etc., etc., is carried on by students under the direction of a professor, or students may be engaged in working up some particular region, often one which they have studied on the spot during a spring or summer vacation.

The department for map drawing and field work is under the charge of Professor Groll. During his illness this summer it was not, however, allowed to lapse, and students had the opportunity of joining excursions for surveying, conducted by an officer of the German army, on the Sundays of the session.

Perhaps one of the most interesting features of the work are the weekly meetings under the guidance of Professor Penck and Professor Grund. The younger students meet every Friday evening from 6 till 8. One of their number reads a paper upon some geographical subject of general interest. During 1907-8 papers were read on such subjects as "Coral Islands," "Circulation of Underground Water," "Sand-dunes," "The Exploration of Australia," "Means of Communication in Russia." After the paper has been read a discussion follows, in which professor and students take part. The Tuesday evening meeting is for advanced students, and not only do men who are working for their degree have an opportunity of attending, but the privilege is extended to others; school teachers, for instance, are able to take advantage of it, and thus to keep in touch with the problems which are interesting geographers at the present day. The papers read at this meeting are usually the outcome of practical original work done by the students. They are either upon a phenomenon studied in nature or upon some particular region. Thus during 1907-8 one student read a paper on "Natural Bridges," while others read papers on particular Alpine regions which had been receiving their attention. In addition to these lectures others are delivered by guests invited by Professor Penck to the meeting. Thus Lieutenant Filchner lectured in 1907 on his work in Tibet, and Dr. Frank Leverett on "Glaciation in the United States." The latter lecture was delivered in English. After the lecture there is again an open discussion, and the lecturer answers questions and replies to the points raised. This meeting lasts like the other for two hours, but so keen is the interest often exhibited during the discussion that it is frequently prolonged beyond this time.

The outdoor work has already been touched upon—it remains only to describe the scientific excursions which may be made in one day or may extend over several days, as in the case of the Whitsuntide excursion. During 1907-8 a day excursion was made to Lindenberg in order to visit the observatory there, and to give a practical finish to

Professor Penck's lectures on "The Atmosphere." The Whitsuntide excursion was a five days' walking tour in Thuringia, and during it valley formation was chiefly studied. In the longer holidays students often carry on practical work, but this, of course, has to be done independently.

The Institute is under the management of Professor Penck, who is assisted by Dr. Quelle and the custodian, Herr Baschin. Professor Penck is also director of the Oceanographic Museum.

The expense involved in the upkeep of such an Institute is a point of interest, and through the kindness of Professor Penck it is possible to indicate generally here the necessary outlay. The administration grants a yearly sum of 5500 marks, and in 1907 an extraordinary grant of 2500 marks was added. In addition to this a further sum of 1000 marks is given yearly for the excursions. Out of this last sum the students taking part in the excursion are provided with maps, and when a student is unable to pay his travelling expenses he may, according to Professor Penck's discretion, receive help in doing so. The men who are engaged in original work may also be helped from this sum. The whole work of the Institute is thus carried on by means of an annual sum of £325, with a possible addition of £125. A student who has matriculated and paid his fees has nothing extra to pay for the use of the Institute, which is open to him daily from 8 A.M. to 9 P.M. When one considers how low even in comparison with our Scottish universities the fees in a German university are, one realises what exceptional opportunities for the study of geography are offered by the Geographical Institute in Berlin.

GEOGRAPHICAL NOTES.

Europe.

The River Wey.—We can only note here, without attempting an abstract, an important paper by Mr. Henry Bury on the part of the river Wey which lies in the Wealden area, which appears in the *Quarterly Journal* of the Geological Society (lxiv. 2). The paper is difficult to follow without its illustrative maps, and we can only mention that it deals with such points as the relation of the Wey to the Blackwater, a point already discussed by Professor Davis in his famous paper in the *Geographical Journal* (v. 1895), and with the anomalous drainage of the Alton district.

Asia.

The Topography of Japan.—We have received a pamphlet with this title, which is a reprint of an article by Mr. Naomasa Yamasaki in the *Encyclopædia Americana*. The article includes not only topography in the strict sense, but also a brief discussion of climate, flora, fauna, and mineral resources. "Japan" here includes both Formosa and the island of Sakhalin (Karafuto). The article gives a concise account of the chief

features of the archipelago, written from the Japanese point of view, and may be cordially recommended to the notice of our readers.

The Survey of India.—Colonel F. B. Longe, R.E., Surveyor-General of India, has issued his report on the operations of his department for the year ending September 30, 1906. The main results are summarised as follows. The total outturn of detail topographical and forest surveys on all scales was 23,312 square miles, as against 26,340 in the previous year. The decrease was due to the shifting of survey parties and changes in the staff inseparable from the process of reorganisation that has been carried on in the Survey Department during the last few years. The reporter states that the publication of the general maps of India is still in abeyance. In 1905 the delay was caused by extensive administrative changes, and in 1906 it was due to the symbols regarding the external boundaries of India remaining unsettled. Consequently the new 1-inch = 32 miles map, sanctioned and begun six years ago, was still unpublished at the date when this report closes. A considerable amount of triangulation work was effected in the Peshawar and Kohat districts. Here the work proves very costly, owing to the necessity of employing strong guards for the protection of the survey parties. At the other end of India a careful survey on modern principles is being carried out in the Gangetic delta, and good progress is recorded in the Sundarbans. A large total of cadastral work has been completed in Upper Burma. Scientific operations have been largely developed of late years by the department. These include astronomical, pendulum, and magnetic observations. A special party was also entrusted with tidal operations, not merely at well-known ports, but also at minor places like Bhaunagar, on the coast of Guzerat. No change in the relative level of land and sea was discovered. Another interesting point is referred to. During the year systematic vertical observations of certain Himalayan peaks, including Nanda Devi, from a station near Dehra Dun, were begun, and it is hoped that after five or six years' observation "the varying effects of refraction and snowfall will be deducible." The report is illustrated by a large number of maps and diagrams.

Dr. Sven Hedin's Expedition.—This explorer, in regard to whose safety some anxiety had been expressed, arrived safely at Simla in September after an adventurous and fruitful journey. It will be remembered that Dr. Hedin began his recent series of explorations in August 1906, when he entered Tibet *via* Chinese Turkestan, crossed the great mountain range to Shigatse, thence found his way to Ladakh, exploring *en route* the sources of the Brahmaputra, Sutlej, and Indus. The results of this first great journey, so far as they are meantime known, have been already indicated here (cf. xxiii. pp. 159, 261, and 599; also xxiv. p. 98). The second great journey, of which details have just come to hand, was organised from Leh in Kashmir. Leaving in December last, Dr. Hedin entered Tibet to the south of the Karakoram, and after extensive exploration in hitherto unknown country in the province of Bongba, returned to Simla *via* Manasarowar. Fuller particulars of this remarkable journey will be given in our next issue.

Polar.

The Mylius Erichsen Expedition.—The *Denmark*, the vessel of this expedition, arrived at Copenhagen on August 23, bringing, however, the sad news that the programme arranged by the leader had been carried out at the cost of his own life, and that of two companions, Lieutenant Hagen and Mr. Brönlund. We detailed here the plans of the expedition in vol. xxii. p. 276, and the report of Lieutenant Trolle, master of the *Denmark*, which we quote below, shows that in all essentials the original programme was carried out, with the result that the unknown north-east coast of Greenland has been charted. In following the account given below, the map accompanying Commander Peary's article (xix. p. 617), will be found useful for reference.

Lieutenant Trolle's report is as follows:—

Mr. Mylius Erichsen, Lieutenant Hagen, and Mr. Brönlund perished in November 1907, in an attempt to return from the north coast of Greenland over the inland ice, having been obliged to remain on the north coast through the summer, owing to the state of the weather. The body of Mr. Brönlund was found in a crevasse near one of our depôts. By the body were found sketches showing the results of the work accomplished and also the dead man's diary, in which was written the following:—

"I perished in latitude 79° north under the hardships of the return journey over the inland ice in November. I reached this place under a waning moon, and cannot go on, because of my frozen feet and the darkness. The bodies of the others are in the middle of the fjord. Hagen died on November 15, Mylius Erichsen some ten days later.—Jørgen Brönlund."

Mr. Brönlund's body was buried on the spot where it was found. It was impossible to recover the bodies of the others, owing to a heavy fall of snow. We erected a monument at Over Haven, Port Denmark, to the memory of our three dead comrades who perished in doing their duty on the field of honour. Everything possible was done to succour them from the ship, but it was beyond human power to prevent the catastrophe.

The course of the expedition was as follows:—On August 13, 1906, we reached the north-east coast of Greenland, and after a difficult passage through the ice the ship reached 77½° lat. north. A depôt was landed at 77¼°, and a harbour for the ship, which was called Port Denmark, was found at 76¾°. It was resolved to remain there during the autumn of 1906, and sledge journeys were made in a northerly direction to establish depôts for scientific research. A great sledge expedition was organised in the spring of 1907, under the command of Mylius Erichsen, to explore the unknown part of the north-east coast of Greenland. The expedition consisted of ten sledges in four batches. Three of these returned before the beginning of summer, and in September 1907 an expedition was sent out to find the fourth party, which had not returned. At 80° the expedition found open sea close to the coast.

In the course of the autumn numerous sledge expeditions started, and in March 1908, a fresh rescue party set out, which brought back definite news of the fate of the missing sledge party. During the spring several other sledge journeys were made on the inland ice towards the south, as far as Ardencaple. The coast of Greenland was explored as far as Cape Bridgman, 83½°, and into Peary Channel to Cape Glacier. The coast-line took a much more easterly direction than was expected, and connection was made with Peary's landmark on Peary Land. At

Cape Glacier the Danish flag was hoisted, and the country taken possession of for Denmark, and called King Frederic VIII. Land. No living people were encountered.

Scientific expeditions were continuously made into the district surrounding Port Denmark, and also from the ship. On the road large collections were made, and a mass of scientific material was collected; numerous sketches, paintings, and photographs of the country were also made. The departure from Port Denmark took place on July 25. Owing to the favourable condition of the ice a cruise was made to 78° N. The members of the expedition are all well, and the ship and collections are in good condition.

Later information shows that Dr. Erichsen and his two companions who perished with him were driven on to an ice-floe during a snowstorm, and that they drifted away from land. Their provisions being exhausted, the explorers became so weak that they were unable to return to the station. The Eskimo who brought the news arrived in a dying condition, and died immediately after making his report.

The French Arctic Expedition.—News has been received from the *Jacques Cartier*, the ship of the French Arctic Expedition (cf. p. 101), which started in April. After touching at Hammerfest, the ship crossed Barent's Sea and reached Bailutsia Fjord in Novaya Zemlya, where extensive surveying was undertaken, leading to the discovery of several uncharted fjords. On July 14 the first fresh food in three months was obtained in the shape of a magnificent goose. The first sledge expedition left the ship on July 25 with provisions for twenty days, intending to cross Novaya Zemlya from West to East, and it was followed by a second six days later. The expedition will probably not winter in Barent's Sea, but will return to Norway and remain there till the spring.

The French Antarctic Expedition.—The ship of this expedition, the *Pourquoi Pas*, left Havre on August 16, and Cherbourg on August 31. We have already given some account of the plans of the expedition (cf. xxii. p. 491, and xxiv. p. 101), but it may be noted that Dr. Charcot is especially desirous of obtaining specimens of the fossils discovered by Dr. Nordenskjöld. The scientific staff includes M. Bourgrain, who will make the astronomical observations, M. Rouch, specialist in meteorology and oceanography, M. Godfroy, who will study the hydrography of the coast and the tides, M. Gourdon, geologist, and Dr. Jacques Liouville, marine zoologist and botanist. The commander himself is a good bacteriologist.

Six automobile sleds, with which Dr. Charcot has already experimented in the Alps, will, it is expected, enable the expedition to make its way well into the interior along the glaciers, and supplement the services rendered by the skis.

General.

The Lecture Session, 1908-9.—Full details of the winter programme of lectures to be delivered under the Society's auspices will be announced later, but meantime members will be glad to learn that the

Right Hon. Lord Avebury, D.C.L., LL.D., F.R.S., has consented to deliver the opening address in Edinburgh on Thursday, 19th November. His subject will be "The Scenery of Switzerland," and the address will be illustrated by lantern views. It will be recollected that Lord Avebury is the author of an important work on the subject of his address, which is one of great interest.

The Society's New Rooms.—The Society's new Rooms, which are now completely fitted up, will be found a great improvement on the old in respect of extent of accommodation. A very much larger area of wall-space than formerly is now available for the display of wall-maps, pictures, etc., and it would add greatly to the appearance of the Rooms to have a more extensive display than is at present at the disposal of the Council. Members of the Society therefore who have in their possession interesting maps, ancient or modern, especially of Scotland, pictures, photographs, or portraits of geographical interest, would confer a great service if they would lend or present these to the Society. Enlarged photographs of regions of special geographical interest would be welcome, as would also framed models capable of being suspended upon a wall.

EDUCATIONAL.

In view of the establishment of a lectureship in geography in Edinburgh University, and the announcement that Glasgow will follow suit, it may be of interest to our readers to detail here the syllabus of the Oxford School of Geography, as an indication of the lines along which the University teaching of the subject is carried on there. In order to obtain the diploma in geography of the Oxford school, candidates must have studied the subject during at least one academic year, and must offer three out of the eight following subjects, of which three Regional Geography must be one. The detailed syllabus follows :

1. Regional Geography.—The cartographical analysis of the physical regions of the world. An elementary knowledge of the chief generalisations regarding the surface-forms of the land, the movements of air and water, and the distribution of plant-associations, animals, and man. The chief facts of modern political and economic geography considered in relation to the influence of physical features. A more detailed knowledge of selected regions. In 1908, British Isles and British lands beyond the seas, Central and Western Europe, and Eastern Asia.

In connection with this subject, candidates will require to be familiar with the principles of map-making, by plane-table, prismatic compass, clinometer and aneroid, the representation of relief, the orientation, reading and measurement of maps.

2. Climatology and Oceanography.—The distribution of solar energy on the rotating Earth and the resulting circulations of air and water. The climatic provinces of the Earth. Methods of meteor-

ological investigation. Oceanic conditions and the methods of observing and representing them.

In connection with this subject, candidates may be required to reduce, tabulate, and plot observations of atmospheric pressure, winds, temperature, and rainfall; or of oceanic depths, temperature, density, and salinity.

3. Geomorphology.—The characteristics, history, and distribution of typical land forms, especially of mountain systems, river courses and river basins, and coastal belts. The configuration of the continents and of the bed of the ocean. A more detailed knowledge of the morphology of Europe.

4. Economic and Political Geography.—The geographical distribution of Man according to race, language, and economic, social, and political conditions. The geographical, economic, and strategic conditions of social and political organisation in the various regions of the world, especially those of economic and historical importance. The main lines of communication, commerce, and migration. Special attention should be given in 1908 to either (*a*) the geographical factor in tropical colonisation and administration, or (*b*) the internal conditions and the external relations (economic, stragetic, and political) of a selected region. (In 1908, Central and Western Europe.)

5. Ancient Historical Geography.—A general knowledge of the historical geography (economic, strategic, and political), of the Roman world, considered in relation to the influence of physical features. A more detailed knowledge of the historical geography of Greece and Italy.

6. Modern Historical Geography.—A general knowledge of mediæval and modern historical geography (economic, strategic, and political), considered in relation to the influence of physical features. A more detailed knowledge of the historical geography of Europe.

7. The History of Geography.—The history of geographical ideas and methods. The outlines of the history of discovery.

8. Surveying.—(1) Field sketching and reconnaissance; (2) Geographical and exploratory surveying; (3) Topographical surveying; (4) Principles of Geodetic surveying, and any one of the following: (5) Engineering surveying, (6) Cadastral surveying, (7) Hydrographical surveying, (8) Magnetic surveying, and (9) Advanced Geodesy.

Under (1) will be included—Scales: Copying, reducing and enlarging maps. Conventional signs. Representation of hill features. Under (2) and (3)—Base-lines. Triangulation. Traverses. Tacheometry and subtense methods. Levelling, determination of altitudes, and contouring. Map projections and graticules. Latitude, longitude, and azimuth. Under (4) a general knowledge of the shape and dimensions of the Earth, and of allied problems, such as local attraction.

Candidates will be required to be familiar with the use of the theodolite, sextant, plane-table, prismatic compass, clinometer, level, aneroid and mercurial barometer, boiling-point thermometer, and planimeter. They may be required (*a*) to measure a base-line, to plan and execute a triangulation over a prescribed area, and to determine the

position of a given point, (*b*) to draw the network of a map to satisfy given requirements, (*c*) to execute a map of a limited area.

Any work previously executed in any of these subjects by the candidate himself may be submitted and will be taken into account.

It is of interest also to add to the above, Mr. Chisholm's syllabus in Geography for the coming winter session, which appears for the first time in the Calendar of Edinburgh University for 1908-9.

Mr. Chisholm's course is to embrace about seventy-five lectures and twenty-five hours' practical work, and is to be held daily during the winter session. The syllabus appears among the courses for graduation in Arts. We give it in full as follows:—

Scope of Geography. Its relation to other branches of study, especially Geology, Economics, and History.

Cartography. The perspective projections and some of the more important non-perspective projections. Conventional signs in cartography.

Form of the Earth. Distribution of land and water. Oceanic circulation, horizontal and vertical.

Meteorology and Climatology. The typical climates of different parts of the world, and their significance in relation to vegetation and animal life.

Typical land-forms and their relation to rock-structure, and the various agents that modify the form of the Earth's crust and affect its value as the scene of human activity. The modes in which the surface of the earth is modified directly and deliberately, as well as indirectly and unintentionally, by man's action.

Economic Geography. The nature of the chief industries in different regions as determined by local conditions and the circumstances of the time. Conditions determining the situation and importance of towns. Special attention will be given in this part of the course to the Mediterranean region and Central and Western Europe, including the British Isles.

Political Geography. Growth of states and determination of national and administrative boundaries. Relation of political and economic conditions.

History of geographical ideas and the progress of discovery. Elementary principles of surveying.

NEW BOOKS.

ASIA.

The Imperial Gazetteer of India: The Indian Empire. Vol. II. Historical. New edition, published under the authority of His Majesty's Secretary of State for India in Council. Oxford: at the Clarendon Press, 1908.

This volume completes the work which under the title of *The Indian Empire* forms the introductory digest of the new edition of *The Imperial Gazetteer of*

India. In this *Magazine* for October, 1907, a brief account of the latter undertaking, and an appreciative notice of the three volumes of the former work that had then been issued, was recorded. The present volume differs from its predecessors in that it has for the most part been planned and written in England, and therefore does not bear the same official sanction of the Government in India as they do. The plan and quality of the volume are, however, virtually the same as theirs. It is divided into sections, and the treatment of each of these has been entrusted to writers who, from residence in or connection with India and their scholarship and researches, are recognised as authorities at first hand on the subjects with which they deal.

The book is not solely a consecutive narrative of Indian historical events. Much more than half of it is occupied by essays on the epigraphy, archaeology, numismatics, architecture, and literature of the Indian continent. These are the sources whence is drawn most of our information as to the ancient history of the Indian peoples. Much of that information is of a hypothetical and hazy character; and the writers of some of the articles in this volume urge with more or less emphasis the need for continued research and study. In illustration of this and as more immediately concerning us, reference may be made to Dr. Fleet's observations on the ancient geography of India (pp. 76-85).

The later sections of the book contain a compilation of the historical events of the country from Mahomedan times onwards. It is founded mainly on contemporary or other chronicles and records, and may be taken as presenting a generally accurate, and, as far as limitations of space allowed, well proportioned —if somewhat bald and colourless—narrative of historical facts.

Altogether the volume contains a vast amount of historical matter, clearly set forth, and well arranged. Its not least useful feature is the bibliography appended to each chapter.

AFRICA.

African Nature Notes and Reminiscences. By Frederick Courteney Selous, F.Z.S. Gold Medallist of the R.G.S. London: Macmillan and Co., Ltd., 1908.

It is not the lot of many to see wild nature as Mr. Selous has seen it, and we congratulate him on the production of such an interesting volume. One who has been a mighty nimrod in his day, and who has had such exceptional opportunities of studying in their native haunts every species of African big game, almost owes it as a duty to the stay-at-home sportsman and naturalist that he should put his reminiscences and impressions on record. We are already familiar from his previous and well-known books on sport and travel with his prowess as a hunter, and it was during these hunting trips that most of the material for the volume under review was obtained.

Little more than sixty years ago vast herds of elephant, buffalo, antelope, zebra and giraffe roamed almost undisturbed, save for an occasional hunter like Gordon Cumming or Oswald, in the fertile plains of what is now Cape Colony, and south of the Orange and Vaal rivers as well as in Natal and Zululand. They have been gradually forced northward, until now, on the banks of the far interior Zambesi the whistle of the locomotive and the sound of the pick is heard, instead of the trumpeting of the elephant and the lion's roar. Just 35 years ago—in 1873—the author describes a sight never to be witnessed again. Far to the south-east of the Victoria Falls, in the Datt Valley, so far as the eye could reach were vast herds of buffalo, and also herds of giraffes, zebras, antelopes,

rhinoceroses. "It is sad to think," he writes, "that of all those buffaloes and rhinoceroses I saw in the valley of Datt on that October evening, less than five-and-thirty years ago, not one single one nor any of their descendants are left alive to-day. They were all killed off years ago, almost all by the natives of Matabeleland after these people became possessed of firearms, purchased for the most part on the diamond fields. The Cape buffalo and the rhinoceros are not yet absolutely extinct in the country to the south of the Zambesi river, but of the great white or square-mouthed, grass-eating rhinoceroses, the largest of all terrestrial mammals after the elephant, none are left alive to-day with the exception of some half-dozen which still survive in Zululand, and a very few which are believed to exist in the neighbourhood of the Angwa river, in Southern Rhodesia. A few of the black or prehensile-lipped species are still found here and there in the high plateaus of the Zambesi river, but like their white congener they are now entirely extinct throughout all but an infinitesimal proportion of the vast territories over which they ranged so plentifully only half a century ago."

Mr. Selous thinks that by the enforcement of game laws restricting the slaughter of wild animals, and the establishment of large sanctuaries in uninhabited parts of the country, it will be possible to preserve in considerable numbers all the many species of antelopes still inhabiting South Africa, as well as the zebra, giraffe and buffalo, but as regards the roaming big-game like the elephant, the rhino and the lion, their ultimate extinction is merely a question of time.

In the case of the buffalo the rinderpest has done more to hasten its extermination than indiscriminate slaughter. Mr. Selous avers that lions and other carnivorous animals seem to have some natural check to their increase, as he has noticed their diminution in numbers in an unaccountable way, notwithstanding that their food supply was abundant, and that they were practically undisturbed by man at the time of which he writes.

Altogether this is a charming volume, and the illustrations are not behind the text in quality.

A map with the present areas of distribution of wild animals shaded in would be an improvement, if a future edition of the book is called for.

AMERICA.

In Indian Mexico. By Frederic Starr, University of Chicago. Chicago: Forbes and Company, 1908.

Many books, good, bad, and indifferent have of late years been written about the northern and better known part of Mexico. The southern states of the republic are the home of more or less pure Indian races seldom visited by foreigners, and the author describes several journeys designed to study the racial characteristics of the inhabitants of these little-frequented regions. His object was to collect statistics of ethnographical value, by means of measurements, pictures, and plaster busts of typical members of each tribe.

The scientific results of these laborious and often difficult investigations have been separately published in a series of papers intended for specialists, and the present volume, as a popularly-written narrative of travel and work, is meant for the consumption of the general non-scientific public.

Mexico, although a republic politically, is not directly ruled by the natives, but by the governors of the respective states, each of whom has the appointment of a *Jefe politico* or chief magistrate for every district or county in the state. It was necessary before the author could begin his investigations, to enlist the

sympathy of the Federal Government, and armed with letters of introduction to the various governors, who in turn directed the Jefes to order the various local authorities to assist him, he was enabled to make a complete series of ethnographical studies of twenty different tribes between the years of 1896 and 1901.

On the southward journey he visited the ruins of Mitla, and stopped on the way to measure the famous cypress of Tule. The stem of this giant of the forest was found to have, at four feet above the ground, a circumference of one hundred and sixty feet. Humbolt, struck by its size a century ago, cut an inscription on it in 1803, which is still visible. Although of immense antiquity this tree is still fresh and flourishing and without a decayed branch, one of the botanical wonders of the world.

A curious cloud phenomenon is mentioned on page 28. As the party crossed the mountains in the land of the Mixes, they were hidden for three hours in thick mist. On suddenly emerging into the sunlight above, they found themselves on the very edge of a great mountain slope. "To our right lay the cloud mass, which was all in movement, precipitating itself into the profound valley. It was a river of vapours, more than two miles, perhaps, in width, plunging, perhaps, two thousand feet into the abyss. Niagara, which I have often seen, is a pigmy cataract in comparison. The cloud mass tossed and heaved, whirled and poured in one enormous mass over the precipice, breaking into spray as it struck against projecting rock masses. Every movement of whirling and plunging water was there; the rapid above the fall, the plunge, the whirlpool, the wild rush of whirlpool rapids, all were there, but all silent, fearfully and impressively silent."

The author used much ingenuity in overcoming the suspicions of many of the natives whom he wished to measure and to make plaster busts, but by dint of cajolery, and what appears in many cases sheer effrontery and impudence, he generally managed to gain his point without much trouble or expense.

At places this bulky volume is loaded with too many accounts of quite insignificant incidents to be very interesting, and the letterpress might with advantage have been compressed into considerably less space. Although well illustrated with photographs, the want of a map detracts considerably from its value as a geographical work. The author underwent considerable discomfort before he could complete his investigations, and was exposed to much danger in the yellow-fever infested district of Tehuantepec. The scientific results of his travels are not stated here, but the pains he took to collect these valuable statistics are deserving of all praise.

GENERAL.

A Scientific Geography. Book I., The World. By Ellis W. Heaton, B.Sc., F.G.S. London: Ralph Holland and Co., 1908. *Price 2s. 6d. net.*

It seems to have become somewhat fashionable of late to endow new geography books with some distinctive epithet in the title. We have here the first of a series of seven volumes of a new book called *A Scientific Geography*; but there seems no special reason for the selection of this epithet—that is, the book is not any more "scientific" than numerous other modern text-books in which an attempt is made to co-ordinate the facts of the subject as causes and consequences. The book is professedly written for advanced students, so that fundamental knowledge is assumed, and the discussion offered is intended to be "suggestive rather than exhaustive." In its nine chapters are discussed astronomical, cartographical, and geological preliminaries; the ocean, atmosphere and climate, the chief natural regions of the world, the most important productions, and the chief facts about

commerce. The book is abundantly illustrated with nearly two hundred diagrams and sketch maps: as these are all in black and white they lack the helpful clearness that colour would impart, and occasionally there is a lack of exact correspondence between the lettering of the text and that of the diagram. The discussion of the astronomical matter tends to be a little heavy. That of the tides is distinctly inadequate, in that for the secondary or remoter tide no better explanation is given than the old-fashioned one of the pulling away of the solid earth from the remoter water. On page 78 there seems to be some confusion between parallelism of contours and their equidistance. In the discussion of monsoons no reference is made to those of the Pacific. It is surely quite wrong to say (p. 236), that Britain produces more coal than the United States; this has not been so for the past ten years. In South Australia (p. 293), the copper mines of the Flinders range are twice mentioned within a few lines, but nothing is said of the more important mines of Yorke Peninsula. The consumption of tea in China and Japan seems to be overlooked on p. 221. Such errors and omissions might have been avoided by more careful revisal of the text; they could less easily be detected by a student. But, nevertheless, the book contains an abundance of suggestive and useful information, and no real student could fail to derive much benefit from its perusal.

Climate, Considered Especially in Relation to Man. By Robert De Courcy Ward. With Illustrations. London: John Murray, 1908. *Price* 6*s. net.*

This book appears in the Progressive Science Series, to which belong many interesting and useful volumes. The author states that he was desired to prepare a book which could be read by any intelligent person who has not had special and extended training in the technicalities of the science, and which should deal with the broad questions of climate. His position and work have enabled him to collect a large amount of interesting material, which is set forth in a fresh and clear fashion in the present volume. After a general introduction, a sketch is given of the zones of climate and their subdivision, the general classification of climates is discussed, and this is followed by accounts of the main climatic characteristics of the zones. After a chapter on the hygiene of the zones, the life of man is considered from the point of view of the modifications induced by the climatic zones, while a final chapter deals with changes of climate. Throughout there is evidence of very wide reading, and the general reader will find much to interest him. From the point of view of the serious student we regret the absence of a bibliography, which occurs in some at least of the volumes of the same series, though it is true that its absence here is to some extent made up for by a section on literature, which directs the student where to look for bibliographical lists. In some cases also it appears to us that the author carries his method of impartial quotation too far. The general reader, who by hypothesis has no basis of expert knowledge which may enable him to differentiate among the various authors quoted, is, we think, often likely to be misled by statements which may not have been intended by their authors to be more than picturesque presentments of a special case, but which are liable to be regarded by non-specialists as of the same value as carefully reasoned scientific statements of fact. We can, however, recommend the book as written in a very interesting manner, and as being full of attractive details.

The illustrations consists of diagrams and sketch maps. We should have liked to have seen also a few good typical views illustrating the characteristics of the main climatic zones; but this was perhaps impossible at the price, which we note with satisfaction is commendably modest.

NEW MAPS.

EUROPE.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st July 1908 :—One-inch Map (third edition), engraved, in outline). Sheets 56, 66, and 71. Price 1s. 6d. each. Third edition, printed in colours and folded in cover, or flat in sheets. Special map of Loch Lomond District, Parts of Sheets, 37, 38, 29, 30. Price, on paper 1s. 6d. ; mounted on linen, 2s. ; mounted in sections, 2s. 6d.

Six-inch and larger Scale Maps. Six-inch Maps (revised) quarter sheets, with contours. Price 1s. each. *Berwickshire.*—(3 SW. and 9 NW.) ; 7 SW., 7 SE. ; 8 SW., 8 SE. ; 9 NE., 9 SW., 11 NE., 13 SW., 13 SE. ; 15 SW. ; 16 NW. *Edinburghshire.*—15 SE. *Haddingtonshire.*—2 SW. ; 4 SE. ; 6 SW. ; 9 NE. ; 11 NW., 11 NE. ; 15 NW. ; 18 SE. ; 20 NW., 20 NE.

1 : 2500 Scale Maps (Revised), with Houses stippled, and with Areas. Price 3s. each. *Peeblesshire.*—Sheets XIII. 2, 3, 6, 7, 8, 9, 10, 11, 13, 15, 16 ; XIV. 1, 5, 10, 12, 13, 14, 15, 16 ; XIVA. 13 ; XVII. 1, 8, 12 ; XVIII., 1, 5, 6. *Wigtownshire.*—Sheets VI. 4, 8, 11, 16 ; VII. 13 ; X. 3, 7, 11 ; (X. 15 and XVI. 3) ; XII. 3, 7, 11, 14 ; XVI. 8, 12, 16 ; XVII. 5, 6, 14, 16 ; XVIII. 3, 6, 7, 8, 9, 10, 11, 12, 14 ; XIX. 5, 9, 13, 16 ; XX. 5, 13 ; XXIII. 2 (6 and 10) ; XXIV. 2, 3, 4, 7, 8, (12 and 16) ; XXV. 1, 8, 12, 16 ; XXVI. 5, 6, 7, 9, 10, 11, 12, 13, 16 ; XXIX. 9 ; XXX. 3 (7 and 6), 8, 11, 15, 16 ; XXXI. 1, 4, 10, 14 ; XXXIII. (11 and 16) ; XXXV. 6, 7, 8 (10 and 9), 11, 12, 16.

Note.—There is no coloured edition of these Sheets, and the unrevised impressions are withdrawn from sale.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st August 1908 :—

Six-inch and larger Scale Maps. Six-inch Maps (revised) quarter sheets, with contours. Price 1s. each. *Berwickshire.*—13A NE. ; 13 NW. ; 16 SW. ; 22 NW. *Haddingtonshire.*—(3 SW. and 3 SE.) ; 5 SW. ; 7 NW. ; 10 NW. ; 12 SW. ; 16 SE. *Peeblesshire.*—12 NE.

1 : 2500 Scale Maps (revised), with Houses stippled, and with Areas. Price 3s. each. *Wigtownshire.*—Sheets VI. 12, 15 ; XII. 10, 15 ; XVI. 4 ; XVII. 9, 10, 13, 15 ; XVIII. 2, 5, 13 ; XIX. 6, 10, 11, 12, 14, 15 ; XX. 9 ; XXII. 1, 2, 3, 4, 5, 6, 7, 10 ; XXIII. 1 ; XXV. 5, 9 ; XXVI. 8, 14, 15 ; XXVII. (9 and 10), 13, 14 ; XXX. 4, 12 ; XXXI. 2, 3, 5, 6, 7, 8, 9, 11, 12, 15, 16 ; XXXII. (1 and 2), 5, 13 ; XXXV. 3, 15 ; XXXVI. 1, 5, 9, 13.

Note.—There is no coloured edition of these Sheets, and the unrevised impressions are withdrawn from sale.

GEOLOGICAL SURVEY OF SCOTLAND —The following publications were issued from 1st to 31st July 1908 :—One-inch Map, Rum, Canna, Eigg, Muck, Sheet 60. Price 4s.

Six-inch Maps, quarter sheets, uncoloured. Price 1s. 6d. each. *Edinburghshire.*—5 NE. ; 15 NW. *Haddingtonshire.*—18 NW.

Sheet Memoirs. The Geology of the Small Isles of Inverness-shire (Rum, Canna, Eigg, Muck, etc.), Sheet 60, Scotland). By Alfred Harker, M.A., F.R.S., with contributions by G. Barrow, F.G.S. Price 4s. 6d.

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for 1907. Price 1s.

GLASGOW.—Bartholomew's District Plan, 1908. Scale 2½ inches to a mile. Printed in colours. Price 1s., mounted on cloth, 2s.

John Bartholomew and Co., Edinburgh.

This new map includes the Clyde from Dalmuir to Bothwell Bridge and from Bearsden on the north to Barrhead on the south. Although comprising such a wide area the scale is yet sufficiently large to show all street names and considerable topographical detail.

EUROPE.—Macmillan's Orographical Map. Designed by B. B. Dickinson and A. W. Andrews. Scale about 1 : 4,000,000. Price 15s., mounted on cloth with rollers and varnished. Descriptive Handbook to Map. Price 1s.

Macmillan and Co., Limited, London.

This is an effective relief map of Europe. In the general view no lettering is apparent ; closer examination, however, reveals names of rivers and initial letters for town names, but it is difficult to understand why all mountain names should have been omitted on an "orographical" map. Teachers will find the handbook a valuable guide to the use of the map.

AFRICA.

GOLD COAST. — Map published by the authority of Sir John P. Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1 : 125,000 or about 2 miles to an inch. Sheets 72 J-I, Aluakru ; 72 K-III, Obuasi ; 72 P-IV, Prestea ; 72 V-II, Axim ; 73 G-IV, Dsoje ; 72 O-II, Yaou ; 72 O-IV, Newtown ; 72 I-II, Debiso ; 72 P-I, Enchi. 1908. Price 2s. each sheet.

W. and A. K. Johnston, Ltd., Edinburgh and London.

AMERICA.

BRITISH COLUMBIA.—Special map of Rossland by W. K. Boyd. 1908. Scale 1 : 4800.

Department of Mines, Ottawa.

ONTARIO.—Department of Militia and Defence, 1908. Topographic Map. Scale 1 : 63,360 or 1 inch to a mile. No. 8, Merrickville Sheet. No. 9, Morrisburg Sheet. No. 10, Brockville Sheet. No. 11, Mallorytown Sheet.

Topographical Section, General Staff, London.

ONTARIO.—Standard Topographical Map. Scale 1 : 500,000 or about 8 miles to an inch. Sheet 29, Lake Nipigon. James White, F.R.G.S., Geographer.

Department of the Interior, Ottawa.

ONTARIO.—Two miles to 1 inch map. Scale 1 : 126,720. Niagara Peninsula Sheet. 1908.

Topographical Section, General Staff, London.

YUKON TERRITORY.—Map to illustrate the summary reports and showing areas of large scale maps published. 1906. Scale 1 : 2,027,520.

Geological Survey of Canada, Ottawa.

ATLAS UNIVERSEL DE GÉOGRAPHIE.—Commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. No. 76. Etats-Unis d'Amérique, Feuille Sud. Est. Echelle de 1 : 5,000,000. Price 2 francs.

Librairie Hachette et Cie., Paris.

ANTARCTIC.

"DISCOVERY" ANTARCTIC EXPEDITION.—Charts by George F. A. Mulock, Lieut.

R.N., Surveyor and Cartographer to the Expedition. 1901-1904. Price 12s. 6d. *Royal Geographical Society, London*, 1908.

Lieut. Mulock's charts form a beautiful cartographic record of the splendid work done by the *Discovery* Expedition under Captain Scott. There are six charts in all. One is general, four show the routes and survey work of the Expedition on a larger scale in considerable detail, and the sixth, on a specially large scale, shows the region around M'Murdo Sound.

BOOKS RECEIVED.

We have received the following books, pamphlets, and reports :—

Das Wetter und seine Bedeutung für das praktische Leben. Von Carl Kassner. Crown 8vo. Pp. vi + 148. *Preis* 1.25 *M.* Leipzig : Quelle and Meyer, 1908.

Leitfaden der Kartenentwurfslehre für studierende der Erdkunde und deren Lehrer. Bearbeitet von Professor Dr. Karl Zoppritz. Part I. Demy 8vo. Pp. x + 178. Leipzig : B. G. Teubner, 1908.

Berlin and its Environs : Handbook for Travellers. By Karl Baedeker. With 6 Maps and 19 Plans. Third Edition. Pp. x + 247. *Price* 3*s.* Leipzig : Karl Baedeker, 1908.

The Castles and Keeps of Scotland. By Frank Roy Frappie. Illustrated. Demy 8vo. Pp. xiv + 411. *Price* 7*s.* 6*d. net.* London : George Bell and Sons, 1908.

The Marches of the Mantze. By J. H. Edgar. Preface by Cecil Polhill. Crown 8vo. Pp. viii + 67. *Price* 1*s.* 6*d.* London : China Inland Mission, 1908.

London and its Environs : Handbook for Travellers. By Karl Baedeker. With 9 Maps and 19 Plans. Fifteenth Edition. *Price* 6*s. net.* Leipzig : Karl Baedeker, 1908.

Mathematical Geography. By Willis E. Johnson, Ph.B. Crown 8vo. Pp. 336. *Price* 5*s. net.* London : George Philip and Son, Limited, 1908.

Commercial Geography. By Henry Gannett, Carl L. Garrison, and Edwin J. Houston, A.M., Ph.D. Demy 8vo. Pp. vi + 415. *Price* 6*s. net.* London : George Philip and Son, Limited, 1908.

The Barbarians of Morocco. By Graf Sternberg. Translated from the German by Ethel Peck. With 12 Illustrations by Douglas Fox-Pitt, R.B.A. Demy 8vo. Pp. xi + 177. *Price* 6*s. net.* London : Chatto and Windus, 1908.

National Antarctic Expedition, 1901-1904. *Meteorology. Part I. Observations at Winter Quarters and on Sledge Journeys.* With Discussions by Various Authors. Prepared under the superintendence of the Director of the Meteorological Office with the co-operation of a committee of the Royal Society. Large 4to. Pp. xiv + 548. London : Royal Society, 1908.

Imperial Gazetteer of India. New Edition. Vols. xv.-xviii. (26 vols. cloth, £5 *net*). Published under the authority of His Majesty's Secretary of State for India in Council. Oxford : Clarendon Press, 1908.

Historical Geography on a Regional Basis. Volume II. Europe. By Ernest W. Dann. Crown 8vo. Pp. 215. *Price* 2*s.* 6*d.* London : J. M. Dent and Co., 1908.

Practical Exercises in Physical Geography. By William Morris Davis. Crown 8vo. Pp. xi + 148. With Atlas. Boston : Ginn and Co., 1908.

Outposts of Empire. By JOHN LANG. With Coloured Illustrations by J. R. Skelton. (Romance of Empire Series.) Demy 8vo. Pp. xii + 286. Edinburgh: T. C. and E. C. Jack, 1908.

Landeskunde der Republik Brasilien. Von RODOLPHO von IHERING. Crown 8vo. Pp. 167. *Preis* 8 *pfg.* Leipzig: G. J. Göschen, 1908.

Applied Geography: A Preliminary Sketch. With 10 Maps. By J. SCOTT KELTIE. Second Edition. Crown 8vo. Pp. vi + 199. *Price* 2*s.* 6*d.* London: George Philip and Son, Limited, 1908.

Mountain Panoramas from the Pamirs and Kwen Lun. With Introduction and Description by Dr. SLEIN. Foolscap folio. Pp. 36. London: The Royal Geographical Society, 1908.

Länder- und Staatenkunde von Europa (Allgemeines) und Mitteleuropa. (Deutsches Reich, Schweiz, Osterreich-Ungarn). Von Dr. LUDWIG NEUMANN. Demy 8vo. Pp. 288. Leipzig: Velhagen and Klafing, 1908.

By the Roman Wall: Notes on a Summer Holiday. By MARIA A. HOYER. With Illustrations from Sketches and Photographs by the Author. Crown 8vo. Pp. xv + 159. *Price* 2*s.* 6*d. net.* London: David Nutt, 1908.

Valladolid, Ovieda, Segovia, Zamora, Avila, and Zaragoza: An Historical and Descriptive Account. By ALBERT F. CALVERT. With 413 Illustrations. Crown 8vo. Pp. 162. *Price* 3*s.* 6*d. net.* London: John Lane, 1908.

Through the Mackenzie Basin: A Narrative of the Athabasca and Peace River Treaty Expedition of 1899. By CHARLES MAIR. Also Notes on the Mammals and Birds of Northern Canada by R. Macfarlane. Demy 8vo. Pp 494. *Price* 8*s. net.* London: Simpkin, Marshall and Co., 1908.

A Hill Country. By RUSSELL F. GWINNELL. With Geological Map. Pp. 26. *Price* 1*s.* London: George Philip and Son, Limited, 1908.

Ice and its Natural History. By J. Y. BUCHANAN, M.R.I. Pp. 35. London: Wm. Clowes, 1908.

Grand Duché de Finland. Helsingfors: Published by La Société de Géographie de Finland, 1908.

Project de Tracteur Auto-Polaire. Présenté par MM. WILLIAM CRUYT et WILLIAM VAN BRABANT. Bruxelles, 1908.

Report on the Administration of Eastern Bengal and Assam, 1906-1907. Shillong, 1908.

Report of the Progress of the Ordnance Survey to the 31*st March* 1908. London, 1908.

Annual Report of the Secretary for Mines for the Year 1907. Melbourne, 1908.

International Polar Commission. Session 1908. Proceedings of the Meetings. Bruxelles, 1908.

Report on the Work of the Survey Department in 1907. By Captain H. G. LYONS, D.Sc., F.R.S., Director General. Cairo, 1908.

Report of the Danish Biological Station 1908. By C. G. JOH. PETERSEN, Ph.D. Copenhagen, 1908.

Administration Report of the Marine Survey of India for the Year 1907-1908. Bombay, 1908.

Catalogue of Maps. London: Published by the Topographical Section, General Staff, 1908.

Publishers forwarding books for review will greatly oblige by marking the **price** *in clear figures, especially in the case of foreign books.*

THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE MEANING AND SCOPE OF GEOGRAPHY.[1]

By Geo. G. Chisholm, M.A., B.Sc.

In opening this course I have the honour to do so as the first lecturer in geography appointed at any Scottish university. That makes it seem appropriate to begin by taking a glance at the history of the university teaching of geography, especially in European universities, for the foundation of the Edinburgh lectureship is only a step in a widespread movement that has been going on both in Europe and America, more particularly within the last forty years. A brief survey of this movement will, I think, prove a fitting introduction to what I am going to take as the main subject of my address, namely, the Meaning and Scope of Geography.

Though the movement in favour of the recognition of the university rank of geography has been most marked within the last forty years or so, we must go back very nearly a hundred years to the foundation of the first university chair in the subject. That took place in France in 1809 when Barbié du Bocage was appointed professor of geography in the university of Paris in the faculty of letters. That remained the only chair professedly devoted to geography in France down to the seventies of last century, but before the close of that decade there were four other university professorships in the country, at Bordeaux, Caen, Lyons, and Nancy, all in the faculty of letters, besides teachers in two of the higher schools having almost university rank, the *École normale supérieure* and the *École des Hautes Études* in Paris. In 1906, the date of the last list of university teachers of geography given in the *Geographisches Jahrbuch*, there were twenty-seven chairs or lectureships in French universities in the

[1] Inaugural Lecture of the first course of Geography in the University of Edinburgh, delivered October 6, 1908.

facultés de l'état, besides five in *facultés libres* and thirteen in the *Écoles supérieures* of Paris. In most cases the professorships are in the faculty of letters, and in several cases the chair is one of history and geography combined.

Germany came next after France in the foundation of university chairs in geography, but down to 1870 there were only two such chairs within the present domain of the German Empire, one at Berlin and the other at Göttingen, and in the year 1870 the Berlin chair, which has been adorned by several geographers of the very highest rank, was vacant. That chair was founded in 1825, when the celebrated Carl Ritter was appointed ordinary professor of the subject. Ritter continued to hold the chair till his death in 1859, but although, as is well known, his labours and genius contributed probably more than anything else to bring the subject into esteem among the learned of that time, his chair was not at once filled after his death, and it was not till 1874 that he found a successor in Heinrich Kiepert. Meantime the kingdom of Saxony had founded a chair at Leipzig, where the acute, energetic, enthusiastic and large-minded Oscar Peschel lectured down to the date of his premature death in 1875. In 1874 the Prussian government formed the resolution to found chairs of geography in all the Prussian universities, but owing to the lack of candidates, this resolution could be carried out only by degrees. At the end of the seventies there were in all twelve chairs of geography in the universities and polytechnica of the German Empire, and the number of professors and lecturers was sixteen. In 1906 none of the universities of the German Empire was without a salaried teacher of geography. There were in all forty-six professors or teachers of geography in the universities, technical high-schools and other educational institutions of high rank, distributed over twenty-eight towns. The university of Berlin alone had two ordinary professors, one of physical and one of historical geography, one extra-ordinary professor, and three *Privatdozenten* in the subject.

Before 1870 Austria-Hungary appears to have had only one professorship of geography, that of Vienna. At the end of the seventies there were lectureships or professorships in that empire at the German universities of Czernowitz, Graz, Innsbruck, and Prague, besides that of Vienna, and at the non-German universities of Budapest, Cracow, and Klausenburg. Since then Agram and Lemberg have been added to the list. Vienna, like Berlin, now has two ordinary professors in the subject, one for physical and one for historical geography, besides *Privatdozenten*. Switzerland has had a university lecturer on the subject since 1866 when J. J. Egli was recognised as a *Privatdozent* at Zürich, where, in 1883, he became extraordinary professor of geography. Now it has professorships or lectureships also at Bern, Freiburg, Geneva, and Lausanne, as well as at the academy of Neuchâtel, most of them in the philosophical faculty (two in the department of mathematics and natural sciences) one in the faculty of letters. Italy, at the end of the seventies, had the subject represented by ordinary professorships at the universities of Bologna, Florence, Naples, Pavia, and Rome, and an extraordinary professorship at Padua, and to these must now be added the universities of

Catania, Genoa, Messina, Milan, Palermo, Pisa, and Turin. In 1906 it had in all thirty-two professors or other teachers of the subject at the thirteen universities named. Denmark has had a professorship of geography at Copenhagen since 1876, and the Netherlands one at Amsterdam since 1877, to which a Lectureship at Leiden has since been added. Down to the end of the seventies of last century no other countries had the subject represented in their universities.

In the following decade, however, a movement in favour of introducing the subject into the English universities began to gather strength, and resulted in the establishment of a readership in geography at Oxford in 1887, and one at Cambridge in 1888. The readership at Oxford has since grown into an important school of geography with several lecturers and teachers attached to it. There is also a lectureship on geography at University College, Reading, which is affiliated to the University of Oxford. In 1908 arrangements were made at Cambridge for the establishment of three lecturers in different departments of geography. When the University of London was reorganised as a teaching university under the Act of 1898 there was no recognised lecturer in the subject except at the Birkbeck Institution (now Birkbeck College), but this was soon changed, and now there is a reader in geography at the School of Economics and Political Science and other recognised teachers of the university give lectures there on the subject, and there is a professor of geography, also a recognised teacher of the university, at University College. The old Victoria University appointed a lecturer in geography at Manchester in 1892, and after the dissolution of this university the Victoria University of Manchester appointed a lecturer in the subject in 1903, and the University of Liverpool made a similar appointment in 1904. Before this lectures on geography were given at Liverpool by the Professor of Political Economy, who is still the head of the geographical department there. For two or three years Birmingham has had a senior lecturer in geography. At Leeds there is no special lecturer, but the professor of geology gives courses in the subject. A lecturer has been appointed this year in the University of Sheffield, and there is also a lecturer in the subject in the University of Wales at Aberystwith. Glasgow has announced its intention of appointing a lecturer, and Aberdeen, I believe, contemplates doing the same.

In the United States there were in 1906 eleven professors or teachers of geography distributed over seven universities or higher educational institutions at Berkeley, Cal., Boston, Cambridge, Mass. (Harvard University), Chicago, New York, Philadelphia, and Princeton. The number has since been increased both by additional appointments at the same universities, and by the addition of other universities to the number having such professorships. There are two professorships of the subject at Harvard, two professors and one "instructor" in the University of Chicago, where the head of the department of geography is the Professor of Geographic Geology, and three teachers of the subject at Berkeley.

Since 1880, Belgium, which had in 1906 eleven teacherships of geography at four universities, besides two at the *École de Commerce*,

Brussels, Russia, which then had thirteen teacherships at seven universities, Norway, Spain, Portugal, Roumania, the Argentine Republic, and Japan have been added to the countries having professorships or lectureships on this subject. Between 1880 and 1906 the total number of university appointments in that subject as enumerated in the *Geographisches Jahrbuch* increased from 47 (one more than the number in the German Empire alone in 1906) to 210.

Now this brief sketch would seem to indicate this, at least, that there is a growing sense of the need in university education for some teaching for which geography is the appropriate designation, and which therefore falls under no other head in the organisation of university studies, and yet at the same time it cannot but suggest a query as to the nature of that study. For we have seen that in some cases geography is assigned to the faculty of letters, in others to the faculty of the natural sciences, and even the mathematical department of that faculty. Various other circumstances tend to give additional force to this query. Now that the subject has been introduced into British universities we find great differences in the position assigned to it among them. At Oxford and Cambridge a special diploma in geography is given. For the Oxford diploma the candidates must satisfy the examiners in at least three prescribed subjects, of which regional geography must be one; the others being (1) climatology and oceanography; (2) geomorphology; (3) political and economic geography; (4) ancient historical geography; (5) modern historical geography, (6) history of geography, and (7) surveying. Under regulations recently passed geography is now also an optional subject for the ordinary B.A. degree. The regulations for the Cambridge diploma before the reorganisation of the school in 1908 were somewhat similar to those of Oxford. In London the subject was made from the first compulsory in the intermediate examination for B.Sc. (Écon.), and has since been made an optional subject both in the intermediate and the pass examination for the degree of B.A. In Manchester the subject is compulsory for the degree of Bachelor of Commerce, and optional both in the intermediate and final examinations for B.A. At Liverpool the regulations are similar, except that there is no degree in commerce expressly so called, but a special degree in arts for students of commerce.

A further strengthening of our query as to the nature of geography results from an examination of the titles of courses delivered by professors and lecturers in that subject. In a recent list of such courses at German-speaking universities, I find, in addition to courses on "general geography," on various regions of the earth, and on cartography, several courses on the morphology of the earth's surface, one on the geomorphological forces, courses on general geophysics, on "the history of the earth; third part, the geography of organisms; fourth part, the geography of man," on the atmosphere, on meteorology and oceanography, on general hydrography, on the historical geography of Germany, on the principles of the geography of settlements and communications, on Marco Polo, on the history of the age of discovery in the fifteenth and sixteenth centuries, etc.

In reading over such a list one cannot but ask, What is the unity in the subject that gives rise to such a variety of separate inquiries? What is the field marked out for geography as distinct from those assigned to other branches of study?

And, in fact, one has to admit that one of the most notable things in connection with geography is that there is probably no other subject the nature and scope of which has been so frequently discussed by those who have adopted it as their own, and that such discussions have resulted in very diverse statements, sometimes in real, sometimes perhaps only in apparent, contradiction with one another. And yet the question cannot be passed over as unimportant. It seems to me essential as a guarantee of steady progress in the study of the subject or any branch of the subject, as a preventive of the waste of time and energy on considerations which do not probably belong to it, that we should be perfectly clear as to the goal at which we want to arrive.

In order to make this as clear as I can, I think I had better begin by mentioning those points about which all are agreed, and then indicating those respecting which there is the greatest diversity of opinion. All (or perhaps I had better say all with one or two exceptions that may be disregarded) are agreed that the subject-matter of geography is the surface of the earth together with what is found on that surface, and there is a general agreement in the view that it includes as an essential part an inquiry into causes affecting those things. It is in virtue of this last circumstance that geography claims to be a science. The chief differences between rival schools of geographers arise from this, that some have insisted on taking man as determining the supreme aim of geographical studies and looking on all branches of investigation in connection with geography as subsidiary to the explanation of the influence of local conditions on human life, while others have sought to bring into independent prominence the study of the forms and physical conditions of the earth's surface and what lies on the earth's surface. The first school is that which is associated with the name of Ritter, who defined geography as being "for us the science (*Lehre*) of our planet in respect of its parts, properties, and essential connections, as an independent planetary whole, in its relations to nature and to man, and to God its creator,"[1] but who in his treatment of the subject aimed primarily at showing by a survey of history the influence on man exercised by the regions he inhabited, and expressly classed geography among "the historical sciences."[2] In Germany, at least, and to some extent elsewhere, the second school is associated with the name of Peschel, whose work was to a large extent professedly a reaction against the tendencies of Ritter, and who devoted his attention chiefly to a number of investigations into physical problems connected with the earth's crust. It is to this side of geography, physical geography, that some would even confine the epithet of scientific.

Many have sought to settle this opposition by claiming for geography a dualistic character, representing it as composed of "two divisions of

[1] *Allgemeine Erdkunde*, edited by Daniel (1862) p. 17. [2] *Ibid.*, p. 23.

equal validity, one of which is connected chiefly with the surface of the earth as regards its physical relations and the distribution of organisms including man, while the other has for its task the explanation of the relations between the surface of the earth and man in the development of his civilisation."[1]

But this assignment of a dual character to our science does not seem satisfactory, and several definitions of geography have been given in the endeavour to mark out a single aim for that study. Dr. Mill has given us three definitions, dating respectively, so far as publication goes, from the years 1899, 1901, and 1902. The first is that in *The International Geography* where geography is defined as "the exact and organised knowledge of the distribution of phenomena on the surface of the earth, culminating in the explanation of the interaction of Man with his terrestrial environment." The second is that given in his address "On Research in Geographical Science" delivered as President of the Geographical Section of the British Association at Glasgow and runs thus:—"Geography is the science which deals with the forms of relief of the Earth's crust, and with the influence which these forms exercise on the distribution of all other phenomena."[2] Obviously this definition to be explicit requires a statement as to the manner in which the science deals with the forms of relief. The third definition is that given in his article on geography in the supplement to the last edition of the *Encyclopædia Britannica*, and is identical with that of *The International Geography* with the omission of the phrase beginning with the word "culminating."

This last definition is also plainly in need of further explanation. One is bound to ask what is meant by "organised knowledge." The further explanation is given lower down where Mill states: "The distinctive task of geography as a science is to investigate the control exercised by the crust-forms directly and indirectly upon the various mobile distributions." This longer definition gives us indeed the needed elucidation of the expression "organised knowledge," but at the same time it somewhat narrows the definition by the introduction of the word "mobile," which I cannot recognise as helping to distinguish the task of the geographer. We can imagine, for example, the existence of a permanent forest under conditions of control exercised by the crust-forms directly or indirectly. Is the existence of that forest not to be regarded as coming within the domain of geography, until perhaps conditions arise which affect its permanence? It is true, indeed, that the permanent forest is a scene of mobility, but the changes in its composition are not such as geography has to do with, but belong to the domain of botanical physiology.

I turn to another definition contained in the most comprehensive and to my mind the most illuminating recent series of papers on the scope of geography with which I am acquainted, that by Professor Hettner in the eleventh volume of the *Geographische Zeitschrift* (1905).

[1] Wagner, in *Geog. Jahrbuch*, vol. vii. (1878) p. 607.
[2] *Scot. Geog. Mag.*, 1901, p. 508; *Geog. Jour.*, xviii. p. 410.

In the paper referred to, Professor Hettner expressly protests against the idea of a dualistic character in geography. That science he places among the concrete sciences, or those which deal with things in all their actual multiformity. Now things may be regarded from three points of view, first, according to their composition and structure (*ihre sachliche Verwandtschaft*), second, according to their development in time, and third, according to their arrangement in space. The sciences which deal with them from the first point of view are the systematic sciences (mineralogy, botany, etc.). Those which deal with them from the second point of view are the historical sciences, amongst which he includes the history of the earth's crust or historical geology. Finally, those which deal with them from the point of view of arrangement in space are the chorological sciences. Of these there are two, astronomy, which deals with the arrangement of things in the universe, and geography, which is "the science of the arrangement of things in space on the earth, or, seeing that we do not know the interior of the earth, we may at once say on the surface of the earth." Such a chorological science is necessary on similar grounds to those which necessitate the chronological science of history, and Professor Hettner states in a note that Kant, in the introduction to his lectures on physical geography, had already drawn attention to this basis of the distinction of geography as a separate science. But Professor Hettner's definition also requires some extension and explanation. He points out that the term "surface of the earth" must not be understood in a narrow sense but must be taken as embracing the earth's crust, its water and other coverings including the atmosphere. He adds that "if there were no causal relations between the different parts of the earth, and if the different phenomena on one and the same spot on the earth's surface were independent of one another, there would be no need of any special chorological cognition (*Auffassung*), but the existence of such relations, which cannot be cognised at all or only incidentally by the systematic and historical sciences, makes a separate chorological science of the earth necessary."[1] Further elucidation of Hettner's point of view is found later on in the statement that "a fact is geographical when, and only when, and in so far as it shows local differences, and when and in so far as these local differences stand in connection as causes or effects with the local differences of other sets of phenomena."[2]

This definition in the light of the explanations here quoted is one that I am prepared to accept. It seems to me equivalent to the second version of the definition of geography above quoted from Dr. Mill's article in the *Encyclopædia Britannica* with the omission of the word "mobile" therefrom, provided that we give a very wide meaning to the indirect control exercised on distributions by the crust-forms. It has indeed been somewhat ridiculed by Professor Davis, who has banteringly remarked that there is nothing geographical in the distribution

[1] *Das Wesen und die Methoden der Geographie* in *Geograph. Zeitschrift*, xi. (1905), p. 554.

[2] *Ibid.*, last sentence of p. 562.

of poetry books.[1] Perhaps not, but if any control of the crust-forms, however indirect, in that distribution can be recognised, then there is. Even then it may not be a geographical inquiry worth making, but that is quite a different thing.

To return, however, to Hettner, if we accept his definition let us see just what it involves. It is for the most part a very difficult thing to discern the full content of very general propositions. The definition is one that seems to me essentially equivalent to one for which I have made myself responsible elsewhere, but which I here quote with a variation indicated by the parentheses enclosing an obviously necessary word. "Geography has three main functions: (1) the determination or ascertainment, (2) the expression, and (3) the estimation or valuation of [terrestrial] local conditions and place relations, that estimation or valuation having reference to the degree and extent of the influence which given local conditions and place relations exercise on other distributions."[2] This definition is also, I confess, in need of elucidation. For what is meant by the influence of local conditions and place relations? Such influences cannot be recognised except in the light of other facts which are not geographical. It may be said that the influence of local conditions is obvious in the fact that certain plants will grow here and will not grow there on account of the difference of climate. True, but that implies that plants have certain requirements as regards temperature, moisture, etc., and that fact is not geographical. Again it may be said that the fact that the British Isles have an exceptionally mild winter climate is a clear instance of the influence of place relations, namely, their vicinity to the Atlantic Ocean; but this implies a whole series of facts, not all geographical, among which may be mentioned that water is more slowly cooled than land, that relatively warm water can impart some of its heat to superjacent air, that the air by its motions can carry that heat from one part of the earth to another, and that the winds during winter blow often enough from the Atlantic to the British Isles to carry to these islands a good deal of the heat so obtained from the Atlantic.

To the definition I have given it may also be objected that it gives no completeness to the subject of geography. It represents the business of the geographer as merely looking for effects without any ideal indication of a beginning or ending of that search, whereas the function of any science must be stated in such a manner as to afford a criterion of when its task is accomplished. That, however, is largely a matter of expression, and I think it is possible to vary the expression so as to meet that objection, and to bring my statement of the function of geography into closer harmony with that which, I say, I accept from Professor Hettner. I would say then that it is the function of geography with respect to any class of phenomena that have a local distribution to explain that distribution in so far as it can be explained

[1] *An Inductive Study of the Content of Geography* (Presidential Address at the Second Meeting of the Association of American Geographers, December 1905), p. 6.

[2] Syllabuses of Instruction in Geography, issued by the Royal Geographical Society, p. 1.

by variations connected with place in the operation of causes whose operation varies according to locality or according to the relation of one locality to another.

By this new version I fear I have made things seem harder rather than easier, but a little examination will perhaps serve to clarify it and to show the necessity for the cumbrousness of its form. The appearance of a man with a strong will and great powers of mind may certainly have an important effect on local distributions, but the appearance of such a man is not to be regarded as a geographical fact unless and until it can be shown that his appearance is due to causes connected with place. Until that can be shown his appearance must by the geographer be accepted as an accident, even though the results of that accident may, from a geographical point of view, be important.

And now with regard to all of these definitions which I take to be equivalent I have to ask, do they serve clearly to mark off the field and functions of geography from those of every other accepted branch of science? I think not. I think that they all include not merely physical geography but the whole of geology under the head of geography. Professor Hettner has endeavoured to guard against this result by making the inquiry of the geologist relate to arrangement in time,[1] and insisting that the inquiry of the geographer has reference solely to simultaneous[2] arrangement in space. But in giving the history of physical features the geologist cannot be required to stop short of his terminal in the present time, and if he does come down to the present time then he has given a solution of a fact of present day distribution in space, and that it will be found, from the very nature of his subject, wholly by means of laws whose operation is determined by local conditions and place relations. To put the same thing in the reverse aspect, if the geographer essays to explain a present day physical feature, such, for example, as the valley of the Neckar, a case considered at some length by Professor Hettner by way of illustrating geographical investigation,[3] he cannot do so without entering on considerations of geological history. "The moment," says Professor Geikie, "the physical geographer begins to inquire into the origin of any particular physical feature, he enters upon the domains of the geologist."[4] Unquestionably.

It was probably with the view of establishing a line of demarcation between geography and geology that Dr. Mill introduced into the explication of one of his definitions as above quoted the word "mobile," but if so it does not meet the case, for the science of geology is founded, one may say, on the very fact that even hills and valleys are mobile. And if that word does not exclude geology from the field of geography, still less does it exclude meteorology, another science which has grown up wholly as a daughter of geography. Marthe, to whom Hettner refers as the first to have sharply emphasised the chorological character of geography, acknowledges that a division can be made between the

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[1] So also Davis, *Systematic Geography* in *Proc. Amer. Phil. Soc.*, April 1902, p. 241.
[2] *Ibid.*, p. 556. [3] *Ibid.*, pp. 626-7.
[4] *Geography and Geology* in *Scot. Geog. Mag.*, vol. iii. (1887) p. 401.

sciences of geography and geology and meteorology respectively only subjectively, not objectively and in respect of definition (*begrifflich*).[1]

And why not recognise this? Surely it does not imply any disrespect to either of the two sciences that are claimed as daughters of geography, for geographers must freely recognise that both of them embrace fields so wide and important as to need independent cultivation, and must recognise, too, that the problems dealt with in both have a degree of definiteness, and the evidence relating to them a degree of clearness which are not to be found in many of the other problems with which geographers have to deal, and that on that account the name of science is more readily accorded to them than to other branches of geographical investigation.

Let us grant then with Hettner that the idea of geography demands that chorological investigation must be all-sided, that all the phenomena of the earth's surface which show local differences, and whose local differences are of importance in relation to other sets of local phenomena demand geographical consideration. One thing must be admitted to follow. The subject is too vast for any one man to embrace. It has of necessity given rise to special sciences for which a special training is required. The geographer, for example, who enters on a geological inquiry can expect to do so with success only in so far as he has received an adequate geological training.

This consideration has led to attempts to narrow the field of geography so as to bring it within more practicable limits. That is quite legitimate, but for the sake of logical clearness I agree with Hettner in thinking that it should be done deliberately and avowedly. The usual method of narrowing the field is to make man the supreme standard of reference, to look upon geography primarily as anthropogeography. As already indicated it was from this point of view that the subject was vitalised by Ritter in the first half of last century long before such a wide outlook could be conceived as that which is now presented for geography in its full extent. But the same supreme reference has been recognised either expressly or implicitly by many geographers who have actually concerned themselves chiefly with the physical side of geography. Incidentally this idea recurs frequently in Peschel, who in more than one passage has given the most unequivocal expression to it,[2] and whose posthumous work, the fragment entitled *Europäische Staatenkunde* is dominated by that idea. The same idea seems to underlie the observation of Supan in speaking of certain changes in the level of shore-lines that "for us geographers the question is so far of importance that shiftings of the shore-line through changes

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[1] P. 628 of vol. vii. (1878) of the *Geographisches Jahrbuch*, where a somewhat lengthy abstract is given of the long and elaborate paper (which I have not read) on the *Begriff, Ziel, und Methode der Geographie* in the *Zeit. der Gesel. für Erdkunde zu Berlin*, vol. xii. (1877).

[2] See the passages quoted on pp. 579-80 and p. 608 of Professor Wagner's invaluable essay on *Der gegenwärtige Standpunkt der Methodik der Erdkunde* in the *Geog. Jahrbuch.* vol. vii. (1878).

of level are still going on,"[1] a remark which recalls the view of Mr., now Sir Clements Markham, who, in a discussion on the limits between geology and physical geography placed the boundary between the two where human testimony ceases.[2] Still more clearly is this idea implied in another of Supan's observations. "The inversion of temperature (that is the increase instead of the normal decrease of temperature with altitude) becomes," he says, "geographically important only where it finds expression in the means of long periods of years, and accordingly belongs to the regular climatic character. In the Alps, as Hann has demonstrated statistically, all the valleys which are shut off from the prevailing winds are characterised by this abnormality, and that is the explanation of the fact that the human settlements with striking regularity avoid even broad fruitful valley bottoms and withdraw to the slopes."[3]

It is to this idea, too, that we owe the last phrase of the definition of geography given by Mill in the *International Geography* already quoted—"culminating in the explanation of the interaction of man with his terrestrial environment," and I have now to add a similar appendix to the definition for which I am responsible stating that it is the business of geography to study the influences of local conditions and place relations "especially on human distribution, and hence on the life of man generally."

Both Davis and Penck consider indeed that anthropogeography is not an adequate equivalent to set alongside of physical geography (or physiography as it is termed by the one, physiogeography as it is termed by the other), and think that this rank can belong only to biogeography or the geography of all living forms. Logically, of course, there can be no objection to this view, but I am unable to follow Professor Davis in regard to the ground on which he considers this division necessary, namely, that the evolutionary philosophy has brought it about that the "content of geography can no longer be defined as the relation of earth and man, but as the relation of earth and life,"[4] and it seems to me that this way of looking at the facts instead of clarifying our notions tends to introduce a new element of confusion into the conception of geography. Under the influence of this view Professor Davis states that "it is the element of relationship between the physical environment and the environed organism, between physiography and ontography (to coin a word) that constitutes the essential principle of geography to-day."[5] Now this is a definition which leaves out the consideration of place, an essential consideration in geography, and includes in geography the whole of animal and vegetable physiology and all the problems of heredity and variation that may grow out of these branches of science. The real effect in geography of the introduction of the evolutionary point of view has not been to alter the nature of the geographical

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[1] *Physische Erdkunde*, 4th ed., p. 369.

[2] *Geog. Jour.*, ii. (1893) p. 520.

[3] *Physische Erdkunde*, 4th ed., pp. 75-6. See also the considerations he advances as to the limits of the temperature zones on p. 94.

[4] *Systematic Geography* in *Proc. Amer. Philos. Soc.*, 1902, p. 239.

[5] *Ibid.*, p. 240. Compare the same authority in a paper on *A Scheme of Geography* in the *Geog. Jour.*, vol. xxii. (1903) p. 414.

problem but to extend the range of considerations, including non-geographical considerations, that have to be taken into account in dealing with certain geographical problems, and it still leaves many problems even connected with human distribution unaffected. If, for example, the question is why the valley of the Nile is, and always has been, the most populous part of Africa (I purposely choose a case of extreme simplicity) the doctrine of evolution has no place in the answer; but if the question is how far geographical conditions explain the present state of the people of Egypt, then we must take into our consideration a course of evolution affecting regions far outside the Nile valley.

Still these special objections to Davis's view of biogeography constitute, as I have already intimated, no reason for refusing to regard biogeography as one of the great divisions of geography. I regard even that division, however, as presenting too wide a field to be occupied by a single man. The considerations connected with biogeography are to so large an extent special to botany and zoology that the problems connected therewith require for their solution trained botanists and zoologists. For practical convenience, therefore, I side with those who make man the supreme standard of reference in geographical study. It is anthropogeography that I will endeavour to present to you to the best of my ability from this desk.

And even that subject is vast enough. Our business, you will remember, is to estimate the value for man of local conditions and place relations, to take into due consideration all that affects such values.

Now that brings us again into intimate relation with sciences that we have already considered and assigned to separate workers, more particularly geology and meteorology.

The relations between geology and anthropogeography are threefold.

(1) The local characteristics on the surface of the earth that are helpful to man, or the reverse, correspond in a large measure to the geological structure. In accordance with differences in that structure the surface may be mountainous or level, fertile or infertile, mineralised or non-mineralised, water-bearing or non-water-bearing. And here I would point out that it follows from this enumeration of contrasts that it is very often the surface or drift geology that chiefly concerns the geographer (from this point onwards I will drop for the most part the anthropo- simply to save breath) not the so-called solid geology, which alone is too frequently represented on geological maps. In studying those surface or drift deposits, moreover, the geographer having a different aim from the geologist may often have to study them under different aspects, taking for example special note of their texture and chemical composition. Even the causes to which these latter characteristics are due may fall under the purview of the geographer. If these characteristics were absolutely unvarying they might be taken by the geographer as given without further inquiry, but so far as they are subject to change the geographer must note the causes of change, and so far as their permanence is due to constant renewal from local causes, as in the flooded areas of the Nile valley, he must note also the local conditions that bring about that renewal.

(2) A second mode in which geography is brought into relation with geology arises from this, that while it is not the business of the geographer to inquire into the history of the earth's crust, it may be of practical importance to recognise that history in certain cases as bringing the physical features of a region or district under one point of view for clearness of apprehension and description. The geological history, for example, throws light on the distribution of the coal-measures on opposite sides of the Pennines, and is even more instructive in the case of the geography of the Weald and its environment.

(3) But perhaps the most intimate of the relations between geography and geology lies in the fact that the same causes that are now operating in such a manner as to affect in a marked degree the value for man of local conditions and place relations are those which are now recognised as playing the chief part in geological history. This fact makes physical geography a common preliminary study for both the geologist and the geographer, although from the difference in the point of view of the two one will lay special stress on certain facts in physical geography, the other on others. This common bond brings both sciences into relation with many others. Both have to study the action of winds and currents, the circulation of water above and below ground, the effects of heat and cold, and so forth.

These also are necessary subjects of study in meteorology, the other science mentioned above as standing in intimate relationship with geography. But here again no exhaustive study of the science is demanded, but only such as will enable the geographer to understand the main influences affecting the climate of a place or region, that is, affecting the average weather conditions as regards rainfall and snowfall, humidity, and temperature.

Further, the other departments of biogeography must not be overlooked. The anthropogeographer must consider how the value for man of local conditions and place relations is affected by the character of the native fauna and flora, the requirements of domestic animals and cultivated plants, and the action direct and indirect of both classes of organisms.

Then, too, the evolutionary point of view on which Davis has laid so much stress must be recognised as of peculiar importance. All the results direct and indirect, deliberate or unforeseen and unintended, of the action of man, whether acting individually, in voluntary association, or in organised communities under one government, as far as they modify place values, must be duly appreciated. If from the point of view of the geography of man we must take into account the nature of the soil and climate most favourable to his chief food-grains, we must also take into account all that relates to the supply of those food-grains in regions where they are not produced in sufficient abundance. If it is the fact that men generally want to buy what they need at the lowest price, and if it is the case that special facilities for production and transport on a great scale help towards furnishing the supply at a low price, the geographer must not omit to note where such facilities exist.

But these illustrations of the duty of the geographer may perhaps

give rise to the objection that after I have handed over one part of geography to the geologist, another to the meteorologist, and others to the botanist and the zoologist, and have nevertheless found it necessary to make even the anthropogeographer trench on the ground of all of them, I am now making him trench on the domains of the historian and the economist. My reply is that I frankly admit it, but that in regard to the life of man so important are the influences attached to local conditions and place relations, that it is of the highest consequence to have a class of investigators whose constant and single aim is to see that the known causes that affect the value for man of place are never overlooked, and to be always searching for unknown causes that have the same effect. And I think I may add as a proof of the weight due to that consideration that it is not among economists and historians that such studies are discouraged, but rather among them that geography, specifically anthropogeography, as a separate branch of study finds some of its most ardent supporters.

I have thus endeavoured to lay before you, and to justify the standpoint from which geography will be regarded in the ensuing course of lectures, but I cannot sit down without making some acknowledgment of the extensive generosity which has been shown by many in the helping towards the equipment of the newly created geographical department of this university. I begin with Government departments and institutions. Through the kindness of Major C. F. Close, R.E., C.M.G., this department has been placed on the free list for new special maps issued by the Topographical Department of the War Office, which has already sent a considerable number of maps and other publications. The Director of the Imperial Institute, Professor Wyndham Dunstan, LL.D., has undertaken to furnish the department with a number of specimens illustrating the resources of different parts of the British Empire. Through the intervention of the Right Hon. Lord Strathcona and Mount Royal, K.C.M.G., the Government of the Dominion of Canada has already sent a number of typical products of the Dominion and is going to send a number more, as well as a copy of the Atlas of the Dominion of Canada prepared under the direction of Mr. James White, F.R.G.S., Geographer to the Government of the Dominion.

I pass now to publishers, cartographers, and others, and in order to make no invidious distinctions, I mention these in alphabetical order. Still, adopting that order, I think you will recognise a certain appropriateness in the fact that I have to begin with the firm of Bartholomew, seeing that the interest which Mr. J. G. Bartholomew has taken in the establishment of the teaching of geography in this university must be well known to most of you. Messrs. Bartholomew have presented to the department their Atlas of England and Wales on the scale of two miles to the inch, the Atlas of Meteorology, and the Atlas of the World's Commerce, as well as the sheets of their atlases of Scotland besides England and Wales made up as wall-maps in sections to suit the convenience of the lecturer. We have next to thank Dr. W. S. Bruce, the organiser and leader of the Scottish National Antarctic Expedition, who has presented the Report of the Scientific Results of the Voyage of the

steam-yacht *Scotia*. Another Edinburgh firm of old renown in connection with geography, Messrs W. and A. K. Johnston, have presented copies of their Royal Atlas, M.P. Atlas, and Commercial Atlas, as well as eleven wall-maps of physical geography. Messrs. Longmans have presented a copy of their *Gazetteer of the World* and one of the latest edition of the lecturer's *Handbook of Commercial Geography*. Messrs. Macmillan and Co. have presented copies of their more important publications connected with the teaching of geography, including *The International Geography*, edited by Dr. H. R. Mill, as well as a copy of their new Orographical Map of Europe, prepared under the direction of Mr. A. W. Andrews and Mr. B. B. Dickinson. The Oxford University Press has presented the complete series entitled *The Regions of the World* (six volumes), edited by Mr. H. J. Mackinder. Messrs. George Philip and Son have presented a copy of their *Mercantile Marine Atlas of the World*; and finally, Mr. Stanford has presented the entire series of seven Orographical School Wall-maps prepared under the direction of Mr. H. J. Mackinder. All these donors I have to ask to accept my hearty thanks in the name of the department. Thanks are also due and are hereby cordially tendered to Mr. David Hay Peffers of Belhaven, Dunbar, who has spontaneously offered to lend gratis to the department at any time when it may be of service old maps from the interesting collection which he has formed and of which some specimens are now shown on one of the walls.

GLACIAL EROSION IN THE SCOTTISH HIGHLANDS.

By Professor Ralph S. Tarr of Cornell University.

(*With Illustrations.*)

Introductory.—Having two weeks of leisure time in the summer of 1907, I decided to spend it in the Highlands of Scotland, primarily for the purpose of seeing how far the topography of that region gave evidence of powerful glacial erosion; and how it compared with other glaciated regions in these respects. As I expected, the phenomena of the Alps, of Norway, of Central New York, of Greenland, of Alaska, and of other glaciated regions, were duplicated here. Having studied the subject of glacial erosion in some detail in various regions of former and present glaciation,[1] it may not be deemed presumptuous on my part if, even though an outsider, and notwithstanding the shortness of my stay, I make a brief statement of the phenomena of glacial erosion in the Highlands as I saw and interpreted them.[2]

[1] In the Alps, the State of New York in the United States, Greenland, and Alaska.

[2] By boat, by rail, by carriage, and on foot I went from Glasgow up Loch Lomond, thence to Lochs Katrine, Ericht, and Rannoch, with some side excursions and walks across country. I then went up the west coast as far as Kyle of Lochalsh with excursions into several of the coastal lochs. Thence by rail I went to Inverness westward by steamer along Lochs Ness, Oich, Lochy and Eil, and after a few short trips round about Ben Nevis, back to Glasgow by rail.

Some Elementary Principles.

Normal Relation of Tributary and Main Streams.—As that eminent Scotsman, Playfair, so clearly stated over a century ago, "Every river appears to consist of a main trunk, fed from a variety of branches, each running in a valley proportioned to its size, and all of them together forming a system of valleys communicating with one another, and having such a nice adjustment of their declivities that none of them join the principal valley, either on too high or too low a level; a circumstance which would be infinitely improbable, if each of these valleys were not the work of the stream that flows in it."[1] The work of a century has not modified this law, which may be accepted as a fundamental principle of physiography.

Wherever one studies valley relations in regions of non-glaciation, the operation of this law is clearly seen. So great a river as the Colorado of western United States, rapidly cutting its way into the strata 6000 feet below the plateau top, has not been able to leave its weak tributaries behind even though they are dry for the greater part of the year. They enter the main stream through valleys at an accordant grade. It is true that there are exceptional cases where a main stream in non-glaciated regions has worked so much more effectively that the side-streams enter through valleys that are out of accord—hanging above the main-stream bottom. Such cases are not only exceptional, but in all cases so far studied they are easily explained as the result of unusual conditions. They are, in other words, abnormal.

Relation of Tributary and Main Streams in Glaciated Regions.—In regions of glaciation, on the other hand, discordance of tributary to main stream is found on every hand; and in places of most vigorous glacial action it becomes almost the rule, thus apparently, in those regions, opposing the Hutton-Playfair law.

Take the case of Alaska, for example.[2] For a thousand miles along the Inside Passage to Alaska one sees instance after instance, numbering hundreds in all, where the tributary valleys join the main valleys at discordant levels, entering them all the way from one or two hundred feet to a thousand feet and more above the main-valley bottom. (See Figs. 1 and 2.) The hanging tributary valley here becomes almost the rule. The same is true in the multitude of branch fiords of this coast. In Yakutat Bay, for instance, the field of my own special studies in Alaska, broadly open tributary valleys breach the walls of the main valleys hundreds of feet above the main valley, perched or hanging there in a most remarkable position (see Fig. 3.) In this region I specifically applied all conceivable alternate explanations, such as differences of rock structure, faulting and others, in each case finding the hypothesis untenable. Only one hypothesis, that of glacial erosion,

[1] Playfair, *Illustrations of the Huttonian Theory*, 1802, p. 10.

[2] See G. K. Gilbert, *Harriman Alaska Expedition*, vol. iii. 1904, pp. 114-119, 139-161, and R. S. Tarr, "Glacial Erosion in Alaska," *Popular Science Monthly*, vol. lxx. 1907, pp. 99-119.

deepening the main valleys in excess of the laterals, is capable of explaining the facts seen there.

If one grants the possibility of glacial erosion operating more powerfully along lines of free flow than others, then the hanging valley is a necessary result. It follows as certainly as accordance of grade does in river work, as Playfair states the law. In view of the fact that hanging valleys would be a normal result of glacial erosion, if one admits the *possibility* of glacial erosion, it is certainly a fact worthy of consideration

FIG. 1.—A hanging valley. Inside Passage to Alaska. To the right of the illustration a white spot marks the waterfall of the stream that flows out of the broad U-shaped valley.

that *such valleys are practically confined to regions of present and former glaciation.*

Most students of glacial action are now convinced that there has been profound glacial erosion in favourable places, though some still oppose this view. Those who have seen in the peculiar topography of glaciated lands clear evidence of powerful glacial erosion, have had much the same task in convincing others that Hutton and Playfair had in establishing the simple (as we now see it) principle of valley formation by river work.

Other peculiar Topographic Features in Glaciated Regions. — Glacial striations, grooves and gorges, like hanging valleys, are confined (unless we include such phenomena as iceberg grooves) to regions formerly

glaciated. Less generally recognised is the evidence of plucking, especially clearly seen in regions of crystalline rocks, like the Scottish Highlands, where the cliffs and exposed ledges furnish definite evidence that the ice was working not merely as an agent of polishing and striation, but also in quarrying. Evidence of plucking is clear on both ends—(*a*) on the ledges, and (*b*) in the boulder-strewn fields where the unconsumed fragments were dumped. Fresh rock ledges, as contrasted with disintegrated and soil-covered rocks, are equally characteristic of regions of recent glaciation.

Smoothing of valley sides and the erasing of minor tributaries is another feature of glaciated lands, and it is often associated with a grooving of the valley sides, giving rise to a series of sub-parallel descending rock-terraces, sloping downward in the direction of ice motion. The erasing of minor tributaries is often so complete that the post-glacial streams of this class descend the valley walls in parallel courses almost flush with the valley slope—not yet having had time to trench the rock with even shallow gorges, and not having even begun to develop a dendritic arrangement of stream course by the coalescing of the close-set, independent streams. In parts of Alaska from which the glaciers have just receded, hundreds of parallel streams descend straight down the valley slope, often only a few feet apart, with no valleys of their own, and no tributaries; and their number increases after a rain. In Scotland, from which the ice has been gone so much longer, the same condition of drainage is present, though the larger streams have begun to cut gorges, and some of the smaller streams have joined the larger as tributaries, making a beginning of the normal dendritic drainage.

Where glacial erosion has been most active it has not only deepened the valleys but has broadened them. Normally a valley that a river is cutting is winding, with a series of rock spurs alternating, first on one side then on the other, and overlapping. One finds this condition almost anywhere that glaciers have not been. But in glaciated regions the overlapping spurs, as well as the minor tributaries, have in many places been partly or wholly erased. Sometimes it is only the tip of the spur that is gone, giving it a truncated appearance (Fig. 4); but in extreme cases the spurs for long distances are entirely gone. This gives rise to straight valleys, with smooth, steeply rising walls, and with hanging valleys in very perfect development. Some of the valleys of the Scottish lochs illustrate this condition admirably; and in Alaska it is so strikingly clear that the straight reaches of the Inside Passage are popularly called "canals." Where is river work giving rise to rock-walled valleys of the "canal" type?

Accompanying these phenomena is a steepening of the valley walls, so that there are two slopes—a lower one where glacial erosion was most active, and has erased much or all of the pre-glacial topography, and an upper one, more gentle, where glacial erosion has done little, and where the older topography has survived (Fig. 4). Sometimes the upper margin of this steepened lower slope is essentially coincident with the level of the hanging valleys; but not always, for the bottoms of the hanging valleys have themselves often suffered glacial erosion to a minor

degree. This is why the hanging valleys are not at uniform levels. Those that have been occupied by the largest and most freely moving glaciers have been lowered most; and thus it happens that the elevation at which two neighbouring valleys hang above the main-valley bottom may be widely different.

Still another peculiar topographic feature of glaciated regions is the presence of rounded knobs, sometimes in the centre of a valley, sometimes on its side. They exist as nunataks in valley glaciers, as islands in lakes, and as rock knobs in valleys. They are residuals left behind,

Fig. 2.—A hanging valley. Inside Passage to Alaska. Waterfall of outflowing stream near centre.

because of hardness of the rock, or other reasons, during the process by which the valley bottom, above which they rise, was being worn away. They are abnormal to valleys of stream erosion, but are common and widespread in valleys sculptured by ice.

In non-glaciated regions, under normal conditions, the headwaters of opposing streams are in divides of more or less definite character, though varying markedly under the influence of variation in rock structure, elevation, rainfall, stage of stream development, etc. But in glaciated lands the divides are often very peculiar, and sometimes quite absent. There is every gradation from the sharpened divide to the flattish col, and thence to what I have elsewhere called the "through valley." The

degree of absence of the normal divide is usually directly proportional to the vigour with which the glacier ploughed across it. In extreme cases the divide has been erased and two streams head in a flat, set low between steeply rising hills; or a lake floods the lowered site of the old divide; or perhaps even a single stream now flows from the one valley to the other. The through valley condition, a great aid to travel in glaciated lands, is found in the Alps, in Alaska, in Central New York, and in the Scottish Highlands. It is as characteristic of glaciated lands as are the hanging valley, the steepened slope, and the "canal" valley, and, so far as I am aware, is all but unknown in regions which glaciers have never occupied.

This combination of abnormal topographic features, so common in glaciated lands, is abnormal only when considered in terms of normal stream-valley formation. It becomes perfectly normal when interpreted in terms of glacial erosion. No other rational explanation has ever been proposed, either for the forms themselves or for the fact that they are found only in regions of present or former glaciation. They are so characteristic that they may be classed among the evidences of glaciation. If all the moraines, till, transported boulders, and glacial scratches could be removed from the Scottish Highlands it would still be possible, on the basis of the peculiar topographic features briefly described above, not only to tell that the Highlands had been glaciated, but even to map the region of most intense glaciation. Some day, and that not very distant, a list of the evidences of former glaciation that does not include the peculiar topographic features will be considered far from complete.

Application to the Highlands.

With this preliminary statement of the phenomena that a student of glacial erosion has reason to expect to find in a glaciated region, let us see to what extent they are illustrated in the region under consideration.[1]

In that part of the Loch Lomond valley that lies within the mountains the valley walls are straightened, and show signs of powerful glacial erosion, with distinct evidence of plucking. There are a number of perfect hanging valleys, especially in the upper portion. Of these the one that enters at Inversnaid may be taken as typical. Back from the lake, toward Loch Katrine, the valley is broad with moderate grade—a typical Highland valley. On approaching Loch Lomond its stream suddenly finds itself without a valley and tumbles down the steepened slope of the main trough, giving rise to the fine waterfall at Inversnaid. The contrast between the grades of the upper and lower course of this stream is no greater than that between the broadly open upper valley and the shallow gorge of the lower portion. It is utterly abnormal to stream work, but finds its counterpart in thousands of cases in Alaska and other glaciated lands.

This valley is hanging also at the eastern end where ice erosion

[1] Owing to an accident to my camera, not detected at the time, my photographs illustrating the topographic forms described below were all failures.

along the Loch Katrine trough has lowered the main valley and left this tributary hanging; but here there is no notable waterfall because the eastward drainage is slight in amount. Thus the valley hangs on both ends, a common feature in glaciated regions where slightly divergent ice-currents crossed two different parts of a single valley. I did not tarry here long enough to work out the full history of this valley further than to satisfy myself that it is an ice-dissected remnant of pre-glacial drainage.

Although there are evidences of glacial erosion in the valley of Loch Katrine and Glen Gyle, my view was so obscured by rain that I am not

FIG. 3.—A hanging valley in Yakutat Bay, Alaska. Note also the steepened face of the two truncated spurs, on either side of the hanging valley.

able to describe it in detail. The phenomena of glacial erosion seemed, however, to be less clear than elsewhere, as would be expected from the direction of the trough.

From Callander northward to Killin the railway follows a through valley at least as far as the western end of Loch Earn. Along this route a number of hanging lateral valleys are plainly visible.

The valley of Loch Tay is a perfect illustration of an ice-eroded valley with fine truncated spurs, glacially grooved slopes, and a system of immature downhill streams following parallel courses in valleys wholly out of harmony with the drainage of a maturely dissected land surface. Several hanging tributaries enter the main trough at different levels, some of the smaller opening into the valley at an elevation of 500 feet

or more, and the larger at elevations of but one or two hundred feet. There are no bays to the lake because ice erosion has left the lateral valleys too high to be flooded by the lake waters. Consequently, like so many other Scottish lochs, it is long and finger-like. It may, in fact, be classed as a "finger lake." Although glacial erosion has been powerful and effective here, it has not straightened the valley to the condition of a "canal." Parts of the spurs are left and the outline is therefore slightly undulating.

In order to examine one of the hanging valleys more closely a journey was made on foot from Kenmore south-eastward to the divide of the river Quaich. The divide is a broad, fairly flat-bottomed col, evidently lowered and broadened by the passage of ice across it. Descending northward from this col there is an undulating moor in a broad, mature, upland valley. A typical upland stream flows through it with a moderate grade, and the road swings up and down over the moor with a general, but gentle, slope toward the north. When the valley lip is reached, above Kenmore, the grade of the road abruptly increases, and descends the steepened lower slope of the Loch Tay valley by a series of zig-zags, all steep. The change in grade of the road is similar to that of the stream which plunges down the hill-side, in a narrow shallow gorge, with many rapids and falls, clear to the Tay valley. In a mile or less the stream tumbles two hundred feet or more. This description is so typical of the hanging valley condition that it might serve for any one of hundreds of instances in glaciated regions here and elsewhere.

From Kenmore to Kinloch Rannoch I followed the mountain road on foot, past the base of Schiehallion. The col is clearly lowered by glacial erosion, but naturally in an upland region the ice was far less active, and its action less concentrated, than in the valleys. Glacial grooves and roches moutonnées forms in the col, and evidences of plucking and large descending grooves on the slopes of Schiehallion, testify that the ice was not inactive even here.

Loch Rannoch valley has been profoundly modified by glacial erosion. At Kinloch Rannoch there is a perfect example of a truncated spur, and there is another to the east and one to the west of it. In each case the spur has a very steep lower face up to an elevation of three or four hundred feet, and above that the surface has the more gentle slope of the maturely dissected pre-glacial land surface. Between the truncated spur at Kinloch Rannoch, and the one just west of it, there is an excellent hanging valley at high level,—500 to 800 feet in elevation—broadly open at its mouth, and with a stream descending from it, down the steepened slope, in a shallow trench, almost flush with the main valley slope, through which the stream tumbles in a succession of cascades. The tributary valley west of this one is also hanging, but since it is larger, and was evidently itself a highway of glacial flow, its lip is much lower, being but little over 100 feet above the loch. There are also hanging valleys on the south side of Loch Rannoch. No valleys cut the steepened slope or gully the lower face of the truncated spurs. They are too new for that.

From Fort-William to Mallaig, even from the railway, it is plain that

FIG. 4.—Truncated spurs. Inside Passage to Alaska.

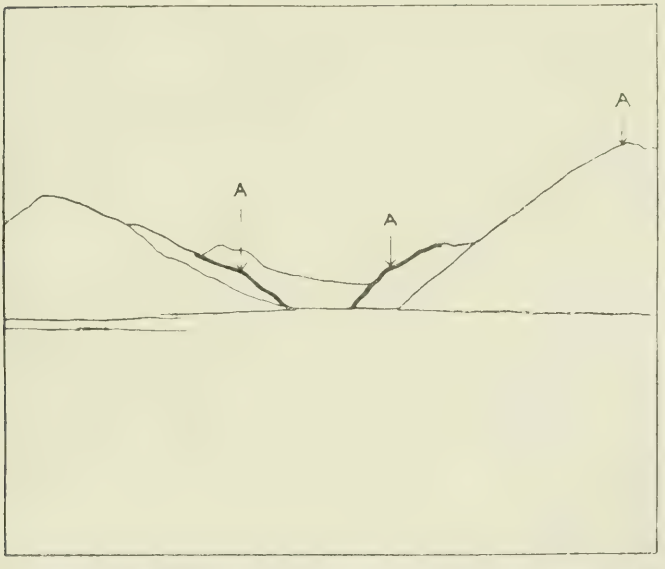

FIG. 5.—A tracing of Fig. 4 to show the change of slope of spurs beneath the letter A—steepened slope below, slightly glaciated slope above the arrows. The outline of the two distant spurs has been inked in order to bring out the change in slope.

there is a series of glaciated valleys; for truncated spurs, steepened

lower valley slopes, with smoothed walls and hanging valleys, are seen every here and there. The larger lateral hanging valleys are themselves broadly U-shaped, indicating that they too were enlarged by glacial erosion, though not sufficiently to lower their bottoms to the depth attained by the main troughs.

A steamboat excursion up Lochs Hourn, Nevis, and Alsh was made during rain, and clear views were rare and local; but enough was seen to convince me of powerful glacial erosion, for all the characteristic topographic features were present. But near the west coast, as at and near Mallaig, where the ice spread out and began to lose that concentration which makes for effective ice erosion, there is clear evidence that the glacier was ineffective. Here there is much irregular rock topography, strikingly contrasting to the rounded surfaces left by vigorous ice scouring; and there is even disintegrated rock in places.

The railway journey from Kyle of Loch Alsh to Dingwall presents further evidence of glacial erosion. There are some small hanging valleys on the sides of Loch Carron, and others up the river Carron valley whose sides are both straight and smooth. The railway slowly rises to the divide, which is flat-bottomed, with a small lake in it, enclosed between steeply rising, smooth-sided valley walls—a stage approaching that of the through valley and made use of for an easy grade across the northern Highlands. Near Luichart Station there are waterfalls where a side-valley enters from Loch Fannich. Below this comes the depression occupied by Loch Luichart, whose depth is probably due to the union of the two glacier currents just above, thus locally increasing the effectiveness of ice erosion. The railway does not descend to the shores of Loch Luichart, but keeps up on the steep slope of the valley until it enters a small hanging tributary, on the north side of which a small stream plunges into the Luichart valley. Through this hanging valley the railway passes to the Garve valley, and here also the lateral is hanging. Thus here, as in the valley between Lochs Lomond and Katrine, there is a dissected remnant of a valley left hanging by glacial erosion on both ends.

Loch Ness is quite like one of the Alaskan "canals." It is remarkably straight, has perfect truncated spurs, numerous hanging valleys, and many waterfalls along its shores. The height of the hanging valleys above the lake level varies greatly and seems to be proportional to the size of the valley, as one would expect. In two cases, both on the north side, the lateral valleys enter the loch at about lake level, forming slight bays. As would be expected, these are the largest tributaries, and hence those in which the ice most nearly equalled that in the main trough in erosive work. Loch Lochy continues the characteristics of Loch Ness.

Whatever the significance of faulting may have been in outlining the main trough of the Caledonian Canal, glacial erosion has certainly put the finishing touches upon it. On the theory of faulting alone it would require great ingenuity to account for the truncated spurs and the difference in level of the hanging tributaries with their broadly U-shape.

In the valleys round about Ben Nevis, notably in Glen Nevis, the

features of glacial erosion are plainly evident, as they are also in the valley of Loch Long.

Thus the evidence, wherever one has reason to expect it, is everywhere the same here in the Scottish Highlands as it is in other glaciated regions. The topography of the crystalline Highlands is in certain significant respects closely like that of the highly folded region of the Alps; of the plateau of Central New York, with the horizontal strata of shale and sandstone; of the crystalline region of parts of Alaska; and of the region of vertical shales and sandstones of other parts of Alaska, as in Yakutat Bay—in fact, in regions of powerful glaciation in general regardless of rock structure. But these topographic features are absent in unglaciated regions, whether we look for them among horizontal strata, as in the plateau of New Mexico, or folded strata, as in the Appalachians of Pennsylvania, or in regions of crystalline rocks, as in the Appalachians of eastern Tennessee, which bear a resemblance to the Highlands of Scotland in other respects. The topographic forms in the Scottish Highlands defy geologic structure; they follow no law except that of persistent association with regions of glaciation and dependence upon the erosive power of glaciers.

The Measure of Erosion.—As I wandered about in the Highlands and saw the hard crystalline rocks deeply grooved, polished, and rounded, I saw what any other student of the subject would have seen—namely, that the glacier had been at work removing rock material from the ledges. The same lesson was taught by the fresh rock surfaces, from which all evidence of pre-glacial disintegration had been removed. Equally convincing was the clear evidence that the glacier was engaged in plucking away larger fragments from the ledges, presented by the hackly surface of the ledges themselves as well as by the vast numbers of boulders deposited all over the Highlands. No one questions this much erosion, but some hesitate to take the next step, just as some long hesitated to believe that rivers could perform the work which every one now assigns to them.

If, however, this measure of erosion is granted, what more is needed than that same element which early geologists hesitated to give to rivers for their work—namely, time? Yes, there is one other element, that of concentration of energy, which rivers also need. A river spread out over the country would be but a poor agent of erosion; but confined along a narrow line it becomes a powerful agent, sawing deeply into the hardest of rocks. Give glaciers time, and even though they grind away but an inch a year, the sum total of their work will become noteworthy, and especially where their currents are directed along narrow valleys and fed from numerous side-valleys.

The argument against glacial erosion has been mainly based upon the supposed ineffectiveness of ice; and this in turn is based largely upon a study of such weak, inefficient agents as the dwindling glaciers of the Alps. Who would think of studying the upper Thames at a period of low water to learn how a Colorado canyon was cut? Yet this comparison is warranted, for the Alpine glaciers are no more to be thought of as in the same category with the profound ice-streams that wound

their way through the Highland valleys than are the Thames and Colorado River. Let the observer go to the huge glaciers of Greenland or Alaska if he would learn what ice is capable of doing.

But I would not rest the argument for glacial erosion in the Scottish Highlands even on this. The topography is the main proof of it, and not merely by comparison with other regions, but even by comparison of different parts of the Highland region itself. Wherever in the Highlands the ice spread out, and hence became ineffective in erosion, one sees the normal conditions of a maturely dissected land surface—normal divides, accordant tributaries, irregularities due to subaerial denudation, and even disintegrated rock. Wherever one enters a trough along which he has reason to expect that ice currents moved vigorously, he finds topographic forms normal to ice work and common in and confined to regions where glaciers have been, but utterly out of harmony with the known results of river denudation—steepened valley walls, truncated spurs, hanging valleys, erased tributaries, lowered cols, and through valleys. To the person who has convinced himself of the significance of these features, everything falls into harmonious relationship. It seems fair, therefore, to ask what other explanation can be suggested that is equally satisfactory? And further, what other argument against it can be urged except that of the preconceived notion that ice cannot erode much—the same dogma that Lyell fought so effectively as applied to the work of rivers?

This paper, as applied to the Highland region, is confessedly based upon a very brief study, though the phenomena are so clear and distinct, and so like those studied much more fully in other regions, that even "he who runs may read." Naturally, under the circumstances, no attempt was made to follow out details, for it was the basal principles only that were sought. I will not, therefore, attempt to say how the various ice currents flowed, nor how much they removed from the valleys. It was clear to me, however, that the ice streams were directed by the local topography along many divergent courses, probably during the stage of most extensive glaciation as well as in the dwindling stages of local valley glaciation. It was equally clear that practically all the good-sized valleys suffered profound glacial scouring and were thereby greatly modified. The measure of glacial erosion in many instances is hundreds of feet, and in places perhaps as much as a thousand feet, thus being comparable to the erosive activity of the Alaskan glaciers and the continental glaciers in the Finger Lake region of Central New York.

The acceptance of the glacial erosion explanation of the topographic features of the Scottish Highlands, described above, leads of necessity to the conclusion that many of the characteristic features of the region are ice-shaped. In large part the peculiarly charming scenery is the product of glacial erosion, coupled with other glacial action. Of course the main mountain forms are of independent origin, though modified in detail by ice scouring. The upland topography is also largely of pre-glacial subaerial origin, though again modified in detail by ice work. But the larger valleys depart widely from their pre-glacial condition.

Doubtless all of them had existence in some form before the coming of the ice; but all the valleys through which ice moved freely have been widened and deepened by ice scouring, different ones to different depths according to the resistance of the rock in which they lie and to the power of the ice current that flowed through them. Some have been eroded so far that their beds now lie beneath the sea, and are occupied by marine lochs.[1] Others have been differentially eroded, forming rock basins in which fresh-water lochs exist, often held up in part, or even mainly, by morainic dams. Still others have been connected with neighbouring valleys by the lowering of divides over which ice currents freely flowed. Altogether, therefore, the drainage has been greatly modified by the ice work; and not least of the effects is the formation of innumerable waterfalls, mainly in association with the hanging valleys. Such are some of the conclusions that the belief in powerful glacial erosion demands—not the making of a new topography, but the shaping and modification of a pre existing land already irregular.

The geographic consequences of this glacial shaping and modification are many and important. Without the lowered cols, the through valleys, and the lochs, we may well believe that the history of the Highlands would have been quite different. Even now not easily accessible, the region would then have been far less so; for from its geologic structure and physiographic history we may fairly infer that its topography would be not unlike the crystalline mountain region of western Carolina and eastern Tennessee in the United States, a region surrounded by a well-settled country, but out of touch with it all, and still preserving customs of a century ago—a barrier to travel, and with no natural highways either into or across it.

After two weeks in the Scottish Highlands, I spent a delightful week in the English Lake District under the guidance of Dr. Marr and Professor Garwood. There the topographic forms found in the Scottish Highlands were repeated, often in most perfect form, as a student of glacial erosion would naturally expect to be the case. Having made this excursion under the guidance of one who is himself making a special study of the physiography of the region, I shall not attempt to describe the phenomena observed; but I cannot resist the statement that the topography of the English Lake District eloquently testifies to the powerful erosive work of the glacial currents that flowed through its valleys. Where, indeed, is there a region of powerful glaciation that does not? Or where is there an unglaciated region that duplicates the abnormal (abnormal to stream erosion) topographic features of the Scottish Highlands and the English Lake District?

[1] It is not intended to deny subsidence as an element in their formation.

THE MISSOURI RIVER AND ITS FUTURE IMPORTANCE TO THE NATIONS OF EUROPE.[1]

By Luella A. Owen.

On account of the enormous growth of industries, and the rapid development of natural resources in the United States during the past ten years, the question of transportation has assumed unexpected proportions, and become a problem calling for immediate solution. The official report of the Interstate Commerce Commission shows that within the time mentioned the volume of railroad business has increased more than 110 per cent., while the increase in railroad mileage amounted to only 21 per cent. As a logical result the roads have become totally inadequate to meet the requirements of commerce, and the stress must be relieved by supplementary facilities that only the inland waterways can afford. For the time being competition is not the chief factor in traffic discussions, although even under present conditions it remains, as usual, an important consideration that cannot be overlooked or ignored. What the roads cannot accomplish the rivers must, and the vast tonnage of both heavy and bulky freight will be transported not only at greatly reduced cost, but also with an economy of time which will figure as a new element in competitive water service.

No expert is required to point out the fact that the heaviest loss and greatest inconvenience resulting from lack of adequate railway service is necessarily borne by the great interior valley lying between the Rocky Mountains and the Alleghanies, and drained by the Missouri and Mississippi rivers. This valley produces the main support of the nation, as well as the major portion of its heavy export surplus; and the most richly productive area is that vast region drained by the Missouri and its tributaries.

The long disuse of this wonderful and unsurpassed system of natural waterways has left the present generation in comparative ignorance of its unmeasured value until a realisation of the overwhelmed condition of the railroads forced a dawning knowledge of neglected possibilities running wild unheeded.

In considering a subject of such wide extent and broad influence, it is necessary to take a purely geographical view on which a clear conception of existing facts and future promise may be based. This includes a more extended range in latitude, longitude, and altitude than even the average inhabitant of the region is accustomed to take note of. The extremes of latitude are from those points on the Canadian line where Milk river crosses and recrosses, to that where the waters pour into the Gulf of Mexico, a total of 20 degrees. The longitude traversed by the waters of that most westerly tributary from their source to the sea is 24 degrees; while the variation in altitude is from sea-level to perpetual snow, which on Long's Peak in Colorado is 14,000 feet, or 4300 metres.

[1] A paper read at the Ninth Geographical Congress at Geneva, July 31, 1908.

As a commercially navigable stream the Missouri is not equalled by any inland waterway in the world; and the force of its strong current can be converted into electrical energy for light and power not only in steep mountain passes and at the Great Falls, but might also be so utilised so far down stream as the cities of St. Joseph in Missouri and Atchison in Kansas, at which points the average rate of flow is about seven miles per hour, the variations ranging from six at extreme low stage to ten at the highest flood. The channel depth here at ordinary stage, between high and low, is about 30 feet.[1] The average fall between Omaha and these points is a little more than one foot per mile, diminishing to less than a foot at Kansas City. Below that the flow is from three to four miles according to stage.

For domestic purposes the water supply is unlimited and pure, for, although far famed for the large amount of sediment held in suspension and transported to the Gulf, this is easily eliminated in settling basins provided for the purpose, and the water which flows off is absolutely pure under a powerful microscope. The supposition that the Missouri received its name from the quantity of solid matter carried is a mistake. The name is that of a once powerful tribe of Indians who welcomed the white adventurers to their lands on both sides of the stream where it flows through the present State, and who pronounced it Miz-zoo-rah or Miz-zoo-ri. The pronunciation with the soft *s* sound is pure Yankee and incorrect.

China alone possesses a river of approximate extent and similar in character, appearance, and commercial value, the Yang-tze-Kiang, whose yellow waters carry the vast interior traffic of a densely peopled region of about the same area, and give colour and name to the Yellow Sea. The Loess colour is also seen in the lower Rhine, although this stream presents no reminder of the two other great turbulent streams beyond the known fact that the Loess deposits on the banks of each have yielded evidence that human beings inhabited the regions before the close of the Glacial Period, and witnessed the causes and effects of a peculiarly interesting geological epoch.

The true head-waters of the Missouri river were not known until the summer of 1896, when a Government exploring party, sent into the mountains of Montana for the purpose of that discovery, completed the work undertaken a year before. The region was surveyed and mapped by these explorers, and in the same year the American Geographical Society published a short account of *The Utmost Waters of the Missouri River*, by Mr. J. V. Brower, who was chief of the party.

A portion of his description is as follows:—

"At the crest of the Rocky Mountains on the southern border of the State of Montana, where the longest branch of the Missouri river takes its rise, the locality is essentially volcanic in its nature, but the eruptive forces have long since ceased to exist there, leaving crater walls and a serrated crest."

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[1] This is the depth at the St. Joseph bridge, where it is 20 feet at low water, and on July 7, 1908, was 40 feet—*by careful measurement* taken by an experienced bridge employee.

"The reconnaissance, which resulted in placing stone monuments on the State line, was principally conducted on snow-capped peaks, where several hundred snow-slides had occurred recently, and during the latter part of June of the present year we encountered snow often twenty and thirty feet deep."

"The ascent of Burbside Mountain was accomplished, beyond which we were unable to pass with horses, on account of the tremendous drifts of snow."

"From every snow-bank along the course of our exploration—and there were thousands of them—a little streamlet proceeded downward, under the rays of the summer's sun, to the lowest depressions of Culver's Cañon, where, uniting, the consequences incident to the birth of a plunging mountain stream were witnessed on every hand."

He also says:—

"The channel distances have been very carefully considered, and all authorities available consulted, with the result that the longest continuous unbroken current of running water in the world, taking its rise near the crest of the Rocky Mountains in the upper portion of Culver's Cañon, State of Montana, thence flowing westwardly and northwardly through valleys that formerly constituted glacial lake beds, the stream, variously designated as Red Rock river, Beaver Head river, and the Jefferson Fork, passes the mouths of the Madison and Gallatin rivers, and flows into the Mississippi above the City of St. Louis."

His carefully calculated total distance from the source under snow-banks at the upper end of Culver's Cañon at an altitude of 8000 feet above the sea, to the south-west pass at the delta of the Mississippi, along the thread of the channel, is 4221 miles. The distance from the same source to the junction of the Missouri and Mississippi is 2945 miles. The total channel distance from the most extreme source of the Mississippi to the same point at the Gulf of Mexico is 2553 miles, which is 1668 miles less than the total main channel of the Missouri to the Gulf, and 392 miles less than the Missouri from its source to their junction.

The volcanic craters among the clouds here described, where the Missouri takes its rise, are only twenty miles, in an air line, from the western boundary of Yellowstone Park, while but twelve miles further eastward the magnificent activities displayed in the geyser basins may indicate that volcanic forces in the vicinity are merely dormant. Where flames appear to leap and flicker in the steaming waters of the Firehole Basin, we find the extreme source of the Madison River, another of the beginnings of the Missouri; while the flow of the Gallatin commences with a combination of waters from hot springs and snow-banks in the north-west corner of the Park. The Yellowstone, which is the largest tributary of the Missouri above the Mississippi junction, takes its meagre beginning on Two-Ocean Pass, at an altitude of 7950 feet, and gains such volume while still in the Park that its low-water discharge at the northern boundary has been estimated at not less than 2000 cubic feet per second, which is the exact volume estimated as necessary to be drawn from Lake Michigan to supply the contemplated 14-foot waterway to

connect the Great Lakes with St. Louis and the Gulf. The altitude at that point is 5360 feet above sea-level, and is the lowest in the Park.

The Yellowstone could be navigated advantageously, not only to this point but also for a distance of some miles beyond, by small steamers of capacity fully equal to those in use by the Americans at Manila for the transportation of both passengers and freight up the Pasig River and across the Laguna de Bay. The Yellowstone was always considered navigable by large river steamers for a distance of 300 miles above the junction with the Missouri, but, unfortunately, it has been closed to navigation for all time by a great dam at Glendive, Montana, whose object is to turn the water into irrigating ditches for converting a vast stretch of semi-arid grazing land into farms to attract a heavy population and induce more varied development in what is essentially a stock-raising country.

Milk River and a large number of other good streams of the smaller class starting from the mountains of Montana and Wyoming, and flowing into the Missouri, are of sufficient size to offer an important mileage of waterways prepared by Nature to carry a heavy traffic so soon as the commercial possibilities of small, light-draught boats shall have come to be recognised in the broad interior West, where their usefulness has never yet been tested. Their value, indeed, could not easily be overestimated, even if the service should be wholly confined to the distribution of products of the coal and lignite mines and oil wells of that region; and yet, by this means vast quantities of ores from the mountains, and grain from fields on the high plateaus, could also be cheaply and promptly transported to home markets; or, if loaded on barges, might be well started toward the shipping port that would be arrived at without breaking bulk. Some conception of the volume of water carried by these streams may be acquired from the mere fact that the width of the Missouri, where it receives the Yellowstone, is 860 yards at the ordinary stage of summer flow, when the depth too is ample for navigation.

Similar conditions as to available small rivers, and serious need of increased transportation facilities, are found in both North and South Dakota, where the situation is obviously more grave than in States better provided with railway service. Their staple crop, wheat, never brings the price of an open market to the producers. They sell of necessity for the price offered by those who can control transportation and ship at pleasure, and who, therefore, reap the greater profit. With transportation on those small streams co-operating with service on the Missouri, sales as well as shipments would be made directly to European countries, which would have become an open market to all the States of the interior. While cost to consumers would be reduced, the producer's profit would increase.

The longest tributary of the Missouri, and also the most peculiar of all American streams, is the Platte or Nebraska. Its two sources start from high peaks of the snowy range of the Rocky Mountains in Northern and Central Colorado, from whence they rush through cloud-bathed parks to leap down narrow gorges into magnificent cañons, and then, after pursuing devious courses to widely distant sandy plains, find their way

to a meeting place in Western Nebraska. Geological observations show that in the very recent past a shallow lake of considerable size existed here, fed by the uniting waters of the two streams poured in from the west and south, and drained by the Great Platte. Numerous flat-topped elevations in the grass-grown lake bed bear witness that the placid surface was dotted with small islands. The scene is of special interest on account of suggesting the idea that the decrease in water supply was of sudden occurrence, it being an established fact throughout the region that if a lake becomes dry from gradually failing flow its bed is so filled with sediment that little, if any, depression remains.

This was the lake of "La Hontan's Limit" on his famous voyage up the Long River. The descriptions of his entire trip are so remarkably correct that every point mentioned, on both the outgoing journey and return, is easily recognised by those who are themselves familiar with the rivers traversed and their shores. The distinctive peculiarities of gradually changing scenes are given with a terse faithfulness quite impossible to one not an actual observer. The key to his misfortune of discredit is readily discovered in the simple fact that after the first few hours on the Wisconsin river he had no correct knowledge of locality. Indian hospitality to strangers was cordial, and guidance through their territory and that of friendly nations freely given, but with some carefully concealed element of strategy designed to prevent a repetition of the journey without the assistance of native guides. The narrative of the Baron La Hontan clearly shows how the deception in his case was accomplished.

As is well known, Indians travelled with incredible speed in their long, narrow canoes, especially when going with the current. After resting and feasting in the country of the "Kikapous," the refreshed party, reinforced by ten warriors, seized with enthusiasm the idea of extending the journey to the "Plantation of the Sun," so it is reasonable to suppose that the canoes moved swiftly. But the account states that having crossed the portage they "embarqu'd upon the River Ouisconsin," and "arrived in four days at the place, where it empties itself into the River Mississippi, which is about half a League broad in that part." . . . "It lies North-East, and South-West; and its sides are adorn'd with Meadows."

Now this is a good description of the junction of the Mississippi with the Missouri, but where it receives the Wisconsin it is only one third of that width, half a mile, and flows from a north-north-west direction through a narrow valley between high rocky bluffs. The distance from the portage is a little less than 200 miles.

As mention is made of the possibility of having passed unseen islands "which the darkness of the night hid from us as we came down," it is evident the party travelled by night as well as day, which makes four days an unreasonable time for the passage of those two hundred miles. Many years later the English traveller, G. W. Featherstonhaugh, gave a description of his descent of the Wisconsin from the portage to the Mississippi in a birch-bark canoe which carried eight persons "commodiously" besides a ton and a half of provisions and baggage. The canoe was "carried by the current, independent of the paddles";

the party camped on shore at night, and the Mississippi was entered at three o'clock in the afternoon of the third day. By vigorous use of oars the time might have been reduced at least half, so it is plain that four days' continuous travel were ample for concluding a down-stream journey so far as the Missouri junction, which was evidently done and the fact concealed from the French explorer by simply misnaming the river whose rapid currents he "stem'd" for twelve days before reaching the Long river. The Platte is readily identified without the necessity of allowances for the influence of time or changed inhabitants. The broad, placid stream with but a narrow channel; the fertile valley on both sides changing to hilly country with wooded shores, and further on to a desolation of limitless plains, followed by a dreary waste of sand: this is the progressive picture even to the present time. The river is remarkable for the absence of short curves in its entire course through the State of Nebraska, and in places the water spreads out in shallow sheets of great breadth almost on a level with the low banks, and in appearance is very like the Bitter Lakes as seen in passing through the Suez Canal. The "Great Island" which "afforded great plenty of Hares," is Grand Island, and the hares were Jack-rabbits which were abundant on the western plains and are not scarce even now, but never quite reached the lower Missouri. The wolves and water-fowl, the Prairie chickens or Pinnated Grouse (called Pheasants), and the "wild Beeves" were all to be found where stated; but the wild turkeys that were sought in vain are known to have first appeared on the Platte in the year 1809.

No reasonable doubt of the journey can be based on the season in which it was made, for although it is usual for the rivers of the region to be closed by ice during a portion of the winter months, there are exceptions to the rule in frequent mild seasons in which that return might be undertaken on January 26, and successfully accomplished. The stream called the "River of the Missouris" was the Osage; and that called the "River of the Osages" was the beautiful Niangua, near the mouth of which a village was burned. A familiar knowledge of the entire region and of its recent past would convince the most sceptic that the Baron la Hontan's description is incontestable proof of his journey up the Missouri and Platte rivers, and that the impossible map was the fruit of Indian cunning. In tardy justice his name should be restored to a place on the geographical roll of honour as the first white man to penetrate into the real heart of the American continent.

The Platte could easily and at reasonable expense be converted into a commercial highway of first importance, navigable by river boats of any capacity. The character of the country through which it flows is such that the work of construction and maintenance would be somewhat similar to that of the Suez Canal, but with all the difficulties occasioned by shifting sand eliminated in eastern Nebraska. The natural supply of water is ample if it were not diverted to other uses, the annual flow of the North Fork alone being reckoned by the chief engineer of the Reclamation Service as "sufficient to cover 1,000,000 acres of land one foot in depth." An enormous dam, called the Pathfinder Project, has been built in eastern Wyoming for the storage of these waters for irrigation.

This dam forms a reservoir having a capacity of 43,560,000,000 cubic feet, which is more than ten times that of the famous Croton reservoir in New York. A storage basin on the South Fork above Denver is being built to have a water surface, when full, of 2000 acres. This is surpassed by one of the greatest dams in the world, which is nearly completed, on the Belle Fourche, in South Dakota, creating a reservoir 60 feet deep with a water surface of about 9000 acres when full.

Irrigation is also too popular in Kansas where the small boat might be effective in the navigation of rivers generally regarded as too shallow for steamer traffic. Even the Kansas is not too large to prove its usefulness, although at Topeka the river has about the breadth and volume of the Seine where it flows through Paris; and the Arkansas might afford valuable transportation to the southern section, below the great dam at Garden City, if irrigation be not too lavish.

If only the surplus waters of excessive floods were to be stored in reservoirs, as was understood to be the purpose when they were being projected, their great and lasting value to the whole valley of the Missouri and its tributaries would be fully comprehended by all who have ever witnessed the havoc created by such floods. But if, on the other hand, these and others under construction and in contemplation shall be allowed to store and distribute an equal volume for irrigation in the more general seasons when no such floods occur, the result must of necessity damage the whole great system of inland water transportation west of the Mississippi. Therefore it can be plainly seen that unrestrained enthusiasm for bringing desert tracts and grazing lands under irrigation may produce results not anticipated, and most disastrous to those regions themselves, as it has been stated by a prominent railroad official that the products of the northern interior States have doubled in ten years, while their railroad facilities increased but one-eighth.

The area of country drained by, and therefore commercially tributary to, the Missouri river and its affluents above the Mississippi junction is equal to three times that of the German Empire; or to the combined areas of Italy, Switzerland, France, Great Britain, and the German Empire, a total of more than 600,000 square miles; and it is the most productive portion of the United States. Various crops predominate in different States and sections of States, from wheat in the most northern to cotton in the southern; the State of Missouri alone being able to excel in the whole range, although its northern limit is in the same latitude as Naples and its southern extreme nearly one degree farther south than the city of Tunis in Africa. Though less than half the size of the State of Montana, Missouri has an area greater by 2572 square miles than that of England and Switzerland combined. Not being under narrow restrictions as to soil, climate and rainfall, this one State grows two-thirds as much wheat as all the Dominion of Canada, and one-tenth of the maize grown in the world in one year; it rivals California in the value of the fruit crop; surpasses all the States in zinc production and many of the Southern States in quantity as well as quality of cotton; all again in horses and mules; takes high rank in production of cattle and hogs, and ships one hundred and seven million dozen of eggs in a season.

These are only a few of the most abundant products of which there is a heavy surplus for export. Each State in the whole drainage system is in various ways a rich producer and a heavy shipper to the markets of Europe, and yet, all the region under discussion could increase its output to an incredible extent to meet demand if there were adequate means of transportation.

In turn, the valley of the Missouri and its affluents is the consumer of an enormous quantity of European raw material and manufactured goods. The transportation of these imports and exports across the country by rail, or partly by rail and partly by the lakes, is much more expensive than carriage by the Missouri river would be; and that without counting a great difference in port charges owing to negro labour in the South being cheaper than similar service at ports in the East, food in the South being a light expense and little clothing required.

With the advent of railroads in the West fifty years ago, transportation on the rivers was almost wholly abandoned and the tyranny of pilots ceased to trouble commerce. The Missouri is naturally a navigable stream but is beset with dangers, from shifting sand-bars and stranded trees, that require specially trained pilots and prohibit night travel. To meet the present stress immediate improvement is imperative, but consists simply in clearing the channel of these bars and snags, and then maintaining it so; with the additional feature of navigation lights to perfect the security of continuous travel with increased speed. This work will be very inexpensive in comparison with the cost of building railroads having but a small fraction of the transportation capacity. The chief engineer in charge of river work at points below Sioux City has estimated that a congressional appropriation of one million dollars would place a dozen parties at work on different portions of the stream starting improvements that four or five millions in successive years would finish. The first year's work would put the river in good condition for navigation from the junction with the Mississippi to Fort Benton in Montana; and following that the channel would be widened and kept clear of obstructions, and the banks protected from encroachments of the current.

A prominent railway authority and official of the Northern Pacific road has estimated the cost of additional track mileage and terminals of capacity to properly move the present freight of the country at $5,500,000,000, but states that this need cannot be met. In discussing the situation he gives the average speed of a freight train as from twelve to fifteen miles per hour, and the average distance travelled by each freight car in service as about twenty-five miles per day; saying, "That is, the entire freight equipment of the country is employed to the fair limit of its capacity but two hours out of the twenty-four. On single track lines freights must wait on sidings while passenger trains have right of way; cars stand for days or weeks in yards, or at transfer points waiting their turn."

The same authority declares that a 15-foot channel from St. Louis to New Orleans would go farther to relieve the entire Middle West and South-West than any other work that could be undertaken, and that with

such a depth of water, a single powerful towboat would carry from thirty to forty train-loads.

Others demonstrate the value of river service by the efficiency of the 9-foot channel of the Ohio as shown by the official report that one steamer sometimes tows as much as 60,000 tons of freight from Louisville to New Orleans on one trip. The horse-power of this steamer is 2175, while that of locomotives to haul the same cargo on a road of average grade would be 24,000. The cost per ton per mile is said to be about one-eleventh of the average rail rate. The average cost of water transportation in the country, in competition with rail, is one-sixth of the cost by rail.

Freight transported down the Missouri river for shipment to foreign ports would have the time advantage of uninterrupted progress; and to the economy of water rates would be added that of no necessity of transfer anywhere between the starting-point and shipping port, even if the start were made in the interior of Montana. And return cargoes of imports would be equally favoured in distribution.

If the markets of Europe were thus opened to direct communication with the unlimited resources and heavy requirements of the Middle West and North-West, the advantages would be mutual and of steady growth. The Missouri river is, therefore, as important to the nations of Europe as to the States it drains.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

Meeting of Council.

At a meeting of Council held on the 8th October, the following ladies and gentlemen were elected members of the Society:—

Principal Donald Macalister, M.A., M.D. B.Sc., LL.D., D.C.L.
G. Keppie Paterson, M.B., F.R.C.P.E.
William Stanford, F.R.C.Inst., F.R.G.S.
Mrs. W. F. G. Anderson.
William King.
Miss Mary Reid.
E. M. Macqueen.

Diploma of Fellowship.

The Council conferred the Ordinary Diploma of Fellowship on G. Keppie Paterson, M.B., F.R.C.P.E., subject to his compliance with the prescribed conditions.

Society's Medals.

The Council awarded the Society's Livingstone Medal for 1908 to the Right Honourable Lord Avebury, D.C.L., LL.D., F.R.S., for his valuable contributions to Geographical Science. The Society's Gold Medal was awarded to Dr. Sven Hedin for his 1907-1908 Explorations in Central Asia.

Lectures in November.

The inaugural address will be delivered by the Right Hon. Lord Avebury, D.C.L., LL.D., F.R.S., in Edinburgh, on the 19th inst. The subject of his address will be "The Scenery of Switzerland."

The Right Hon. Sir Herbert E. Maxwell, Bart., F.R.S., LL.D., will deliver the opening lecture at Aberdeen on the 25th inst., when he will take "Forest Resources of the United Kingdom" as the subject of his address.

Majority Celebrations of the Buchan Field Club.

Professor J. A. Thomson, of Aberdeen University, represented the Society at the Majority Celebrations of the Buchan Field Club, held at Peterhead on October 10, and delivered a congratulatory address on behalf of the Society.

GEOGRAPHICAL NOTES.

Europe.

The Pelagian Islands.—The islands of Lampedusa, Lampione, and Linosa, the Pelagian Islands of the ancients, are not much known to the public. Of little economic value, owing largely to the scarcity of drinking water, they have remained unnoticed during the great migrations of the past. In 1820 Captain Smyth visited them and recorded his observations in his *Sicily and its Islands*, and later, Italian scientists have from time to time studied the physical conditions of this little group. Of late, however, Stefano Sommier has given the subject his attention, and has published the results in a book which is reviewed in the *Rivista Geografica Italiana* for June (*Una Monografia delle Isole Pelagie*). For many generations the islands were nearly uninhabited, but recently the Italian Government has encouraged immigration, and even established a penal settlement in Lampedusa, and at present the population of that island consists of 2000 free settlers and 500 convicts. Water, as has been said, is very scarce; watercourses there are none, the few springs are brackish, and the only supply is the rainfall. Living is therefore difficult, and the chief article of cultivation is the recently introduced Indian fig. There are flocks of goats and sheep, but the staple industries are sardine and anchovy fisheries all round the islands, but most abundant near Lampedusa.

The Pelagian islands lie in the line between Sicily and Africa, but closer to Africa. Geographically, indeed, they belong to the coast of Tunis, ethnically and politically to Italy. The geology is interesting, for while Lampedusa and Lampione are composed of sedimentary calcareous formations similar to the adjacent coast, Linosa is purely volcanic. The chief object of Sommier's visit was to make a list of the flora, and his conclusions are of interest. The plants are Afro-Sicilian

in character, but contrary to expectation, although the group is nearer to Africa, Sicilian types predominate. With regard to Lampedusa and Lampione, it has been suggested that African varieties may have persisted from the period when still these islands were united to the mainland, but Sommier thinks there is no evidence of this; he believes that all the plants found at the present day have been introduced by external agencies, winds, tides, birds, and the like, and that the predominance of the Sicilian types is to be accounted for by the direction of these winds and tides. The migratory birds also, of which countless numbers pass over, would tend to introduce seeds from the fertile north, rather than from Africa. The fact that the flora of the volcanic Linosa closely resembles that of the other islands lends support to Sommier's views. Captain Smyth says, "I put some goats and rabbits ashore," at Linosa, but according to Sommier these have all disappeared.

Asia.

Dr. Sven Hedin's Journey.—We briefly noted in our last issue the fact that Dr. Hedin had successfully completed his second great journey. The main results of this journey may now be summed up. The caravan, consisting of eleven men with forty animals and three months' supply of provisions, started north in December from Leh, but two days short of the Karakorum Pass turned due east.

The explorer immediately began to encounter hardships. Snow fell continuously and the animals began to die, but the Aksai Chin Lake was reached in January. There a connection was established with the observations made for a map on the first journey. Thereafter the difficulties increased; snow fell day and night and the road became obliterated. The caravan was in terrible straits, and it seemed hopeless to expect to survive. The lowest temperature, $-39{\cdot}8^{\circ}$ Centigrade, was registered on January 15. Dr. Sven Hedin's feet were partly frozen and all the sheep taken with the party for food died. Eventually they reached Shementso, where friendly nomad hunters provided them with antelope and sheep.

A march of 20 days to the east-south-east followed, Lemchang Lake being passed. Several gold-fields were seen on this section of the route, but they were deserted, as the miners only work during the summer. Evidence of water channels for washing the gold out of the earth proved that the industry is carried on on a fairly large scale between latitudes 32° and 34°.

Here a plunge into unknown country was made, Dr. Hedin assuming a disguise and destroying everything which might indicate European nationality.

The unknown tract ended at Tongtso, just north of latitude 32°, where the routes of Nain Singh, Littledale, and Sven Hedin himself in 1901 crossed, thus establishing fresh connection with past mapping.

Dr. Sven Hedin then went along the northern edge of the great tract between latitudes 30° and 32°, stretching from his old route to the Brahmaputra, which was the great object of his journey. He marched

due south, crossing several ranges all running east and west. The country was bare, and he obtained food from the nomads. He passed the enormous ice mountain of Shakangsham on the east, from which flowed the big river. Thence he went over the Ladang pass into the open valley, and the Bongba province, which no European has ever entered and whose name is almost unknown, lay open before him.

Dr. Sven Hedin then discovered Lake Chunitso, following the west shore for a whole day. There he saw caravans of sheep carrying salt, and first heard of the great salt lake of Tabia Tsakha, which is a source of considerable wealth to the government, the salt being exported in large quantities east and south, also into Nepal.

Two more ranges were crossed, and then the open plain was reached, bounded southwards by that great mountain range, 2000 miles long, which stretches east and west. It is the grandest physical feature north of the Brahmaputra Valley. Snow and glaciers everywhere bounded the horizon.

Dr. Sven Hedin was rewarded by discovering the continuity of the chain. Nain Singh in 1865, Rawling and Ryder in 1903, and Dr. Sven Hedin himself in 1906 had seen some of these lofty peaks, but no one had approached them from the north between longitudes 84° and 85°. The pass called Samyela, 18,000 ft. high, gave approach to the watershed between Central Tibet and the Brahmaputra. This was the eighth time Dr. Sven Hedin had crossed this great range at various points, naming it originally Ninchantangla, after the high peak of 23,900 ft. which springs up from the southern shore of the Lake of Tengri, not far distant to the eastwards.

When leaving Ladakh the explorer thought that he would be satisfied with exploring Bongba and testing the continuity of the range, afterwards reaching India *via* Nepal or Shigatse, but the success gained stimulated him to solve the problem of Chartatsangpo, a big affluent of the Brahmaputra. He found that its course had been wrongly marked on the maps. Chartatsangpo is fed from the huge snow-peaks, a lake being formed whence the river reaches the Brahmaputra.

Leaving this on May 5, Dr. Hedin travelled due north, crossing a pass of 19,000 feet in the Great Range, and made for Lake Tedenam, the existence of which Nain Singh reported in 1873, its real name being Terenam. He found the lake to be long, narrow, and salt, and entirely different from its representation on the map.

He then turned westward and visited the Mending temple, situated on the bank of the Somatsangpo, the largest river in Tibet without outlet to the ocean. He failed to meet the main body of the caravan, but travelled in Tibetan dress, quite unmolested, by a route west-south-west. Crossing a range 20,000 feet high, he reached Khala, shown on the maps as a great peak, but really a pass in a high range running from the main system. He then came to Ghalaringtso, which is described in the maps as containing a monastery on an island. Its real name is Ngnanglaringtso, and there are five islands. The shape given in the maps is wrong, as it runs east and west and is intersected by three rivers. The explorer crossed the Great Range for the tenth time, and reached

Manasorawar on July 26, and thence by known roads made his way to Simla.

The new map of Tibet will be of 900 sheets, which proves the extent of the exploration. All the heights of the passes, the river crossings, and the encampments are recorded; a hundred astronomical points have been fixed; several thousand panoramas have been taken, with compass bearings and names. Dr. Sven Hedin has brought back photographs, pencil drawings, and water colours. Meteorological observations were made three times daily, and the explorer has geological specimens, with the dip and fall of the rocks, from 1200 different points. The total length of his journeys was 4000 miles.

In Dr. Hedin's opinion the most important point brought out by his expedition is the discovery of the continuous mountain chain which, taken as a whole, is the most massive range on the crust of the earth, its average height above sea level being greater than that of the Himalayas. Its peaks are 4000 ft. to 5000 ft. lower than Everest, but its passes average 3000 ft. higher than the Himalayan passes. The eastern and western parts were known before, but the central and highest part is in Bongba, which was previously unexplored. Not a tree or a bush covers it; there are no deep-cut valleys, as in the Himalayas, for rain is scanty. The absolute heights remain to be calculated from observations made on the ten passes crossed. The range Dr. Hedin proposes to call the Trans-Himalaya range.

Dr. Stein's Expedition.—The account given in our May issue (p. 262) brought Dr. Stein's exploration down to December last. Letters are now available which summarise the winter's work, then on the eve of beginning at Karashahr, in the extreme north-east of the Tarim basin. Sites of ancient towns of some size could be traced at several points of the Great Plain, now mainly a waste covered with scrub and low jungle, which encircles the Bagrash lake on the north. But the vicinity of subsoil water, often impregnated with salts, and the effects of a climate evidently less dry than in other parts of the great Turkestan depression, had completely destroyed whatever structures might have once stood within the still extant clay ramparts. A far better field for systematic excavations was offered by an extensive collection of ruined Buddhist shrines, locally known as Ming-oi ("the thousand houses"), which occupies some low rock terraces at the eastern-most foot of the range overlooking the Karashahr river from the south. Here excavation yielded excellent results, especially as regards sculptures and paintings.

Dr. Stein could not trace in the vicinity any remains pointing to early occupation by villages. Yet the wide plain stretching eastwards, a desolate waste of scrub and sand, could even now be easily brought under irrigation by canals from the Karashahr river. Whatever changes desiccation may have effected in this region, it seems certain that the supply of water now available in the Karashahr river far exceeds the needs of the narrow strip of land actually cultivated, chiefly by colonies of restless Tungans and semi-nomad Mongols, and that only the want

of adequate population at present prevents a great extension of cultivated area. After the completion of their tasks by Christmas, it was a relief to the party to move up to the cold but sunny hills of Khora, two marches from Ming-oi. Surveyor Rai Lal Singh had rejoined Dr. Stein at Ming-oi, after making his way from Turfan towards Korla, largely through previously unmapped portions of the Kuruk-tagh ranges. The visit to the Khora ruins gave Rai Lal Singh an opportunity for useful surveys on the range dividing the Karashahr valley from the open plain of the Tarim basin.

After a visit to the Inchike (or Shahyar) river, the party marched over hitherto unsurveyed ground to Kuchar, Rai Lal Singh following the course of that river through its debouchure from the mountains, while Dr. Stein struck across the broad belt of waterless desert to the north-west. After a week's halt at the oasis of Kuchar, which was utilised for visits to the ruins and a rapid study of their specially instructive features, Dr. Stein was free by the close of January to resume his journey to the south of the desert.

Inquiries set on foot by Dr. Stein since leaving the Khotan and Keriya region in the autumn of 1906 had resulted in information reaching him about several ruined sites in the Taklamakan which had remained unexplored so far; and he was anxious to visit them before the heat and the season of sandstorms made work on that ground impossible. On January 29 the party left the last shepherd huts in the Tarim jungle, and after a trying tramp of eight days across high dunes they reached the northern edge of the dried-up delta, which the Keriya river had formed at some early period. There was nothing here to indicate the right channel in the maze of dry river-beds, all half-buried by drift sand, and often disappearing completely amidst jungle dead since long ages. The river had formed a new bed far away from the one which Dr. Hedin had followed, and the sands through which it now flowed were still absolutely sterile. It was a great relief when Dr. Stein at last sighted, from a huge ridge of sand, the glittering ice-sheet in the distance. It took several days more before they arrived at living forest, and found the river-bed branching off from the old one, close to the northernmost point Dr. Stein had reached on his journey of 1901.

After a day's rest at a shepherds' camp by the Keriya Darya, Dr. Stein resumed archæological labours at the Kara-dong site, which he had visited on his previous journey, and which the river, by its latest shifting, has approached again after long centuries. Having been joined on the Keriya river by a party of his old "treasure-seeking" guides from Khotan, Dr. Stein marched with them by a new route to the desert edge north of the oasis of Domoko. Here excavations were rewarded by valuable finds in the shape of well-preserved manuscripts in Indian scripts, Buddhist paintings on wood, etc.

March and the early part of April were thus spent in archæological labours along the desert belt adjoining the oasis from Domoko to Khotan. Amongst the ruins newly traced there Dr. Stein mentions the remains of a large Buddhist temple, decorated with elaborate frescoes, now completely buried by high dunes in the desert strip between the

Yurung-kash and the Karakash rivers. Like the large Rawak Vehara which Dr. Stein discovered in 1901 in a closely corresponding position not far from the opposite bank of the Yurung-kash, this temple proved to belong to the early centuries of our era. Unfortunately subsoil moisture had weakened the walls to such an extent that continued excavation threatened to result in complete destruction.

After having been rejoined by Rai Lal Singh, who had in the meantime completed a detailed survey of previously unmapped ground in the north-west and north of the Khotan oasis, the party set out by the desert route which leads towards Aksu along the Khotan river-bed, then practically dry throughout. On the curious desert hill of Mazar-tagh, which flanks the Khotan river on the west, some six marches below the oasis, Dr. Stein discovered the ruins of a fortified watch station once guarding the river route. The fort had been destroyed by fire, but on the steep rock slope below big masses of refuse thrown out by its occupants in the course of long years had fortunately remained in excellent preservation, safe from moisture and driving sand. From this unsavoury quarry Dr. Stein recovered a great collection of documents on wood and paper, in a variety of scripts, mainly Indian, Chinese, and Tibetan, and none apparently later than the eighth and ninth centuries A.D.

By the beginning of May the expedition reached Aksu, having suffered a good deal on the way from the heat of the desert and sand-storms. At Asku Dr. Stein was able to arrange for the local help which Rai Lal Singh needed for the continuous survey he was to carry along the outer Tian-shan range westwards as far as the passes above Kashgar. Dr. Stein himself travelled up the Uch-Turfan valley, and thence marched by a route not shown by published maps across a barren but remarkably picturesque mountain range to the oasis of Kelpin. In spite of peaks rising from 12,000 to 13,000 feet, water is now very scanty throughout these mountains.

The way in which obvious desiccation has affected the conditions of Kirghiz herdsmen grazing in the valleys, and the survival among them of local lore unmistakably of pre-Mahomedan origin, offered interesting objects of study. Information opportunely secured through "treasure-seekers" of Kelpin led to the discovery of extensive *débris* areas, marking ancient settlements in the desert belt between the arid outer hills of Kelpin and the lowest course of the Kashgar river. Far-advanced erosion had left little or no remains for excavation, but enough archæological evidence was secured to prove that this tract, once traversed by the ancient Chinese high road to Kashgar, had been occupied down to the eighth century A.D. by large settlements to which canals still traceable in parts carried water from the Kashgar river. There was opportunity here also for interesting topographical work, as Dr. Stein's survey revealed a series of low parallel ranges, which continue to the north-west the line of the curious rugged hills about Tumshuk and Maralbashi shown by the extant maps as isolated rock islands.

A rapid journey *viâ* Yarkand brought Dr. Stein by the middle of June back to Khotan. After completing his task of packing and

arranging his collections at Khotan, Dr. Stein hoped to carry out, with Rai Lal Singh, explorations in those parts of the high Kunlun range about the Yurung-kash and Kara-kash sources which still remain to be surveyed. Then, late in September, Dr. Stein hoped to be able to start on the return journey to India over the passes of the Karakorum, and may be expected in England in December.

Exploration in the Himalayas.—Dr. and Mrs. Bullock Workman have spent the summer season in making a detailed survey of the Hispar Glacier and its branches.

Much of topographical and glaciological interest was discovered in the exploration of the northern branches, which are from twelve to fifteen miles long, their actual topography being found quite different from that shown on existing maps. A base camp was established, at 16,000 feet, on the last mountain flank below the ice falls leading to the Hispar Pass, and from here various ascents were carried out. The most interesting and, because of its extended view, of much topographical and geographical importance, was that of a sharp triangular snow pyramid crowning the watershed between the Hispar and Biafo Glaciers. From a snow camp, at over 19,000 feet, Mrs. Bullock Workman, guide, and two porters, climbed over a dangerous, precipitous, icy arête of 2000 feet to the summit, which is between 21,000 feet and 22,000 feet, while Dr. H. Workman at the same time ascended a somewhat lower mountain for photographic and observation purposes. The view before referred to from the higher peak included the full sweeps of the thirty miles long Hispar and Biafo Glaciers and the great peaks to the source of the Baltora, more than sixty miles distant to the east.

On completing the Hispar survey the expedition crossed the 18,000 feet Hispar Pass, and, after investigating a large unknown glacier running south-east from Snow Gake, at the head of the Biafo, descended the Biafo Glacier to Baltistan. Mrs. Bullock Workman is the only woman who has traversed the Hispar and Biafo glaciers.

Africa.

Italian Somaliland.—The *Bollettino della Società Geografica Italiana* for July 1908 contains a note on the new agreement between Abyssinia and Italy, dated 16th May 1908, having for its object the definition of the boundaries of Italian Somaliland and Italian Dankalia. A short history of Italian enterprise in these regions during the past fifty years is given, together with the text of the final treaties, and a useful provisional chart of the two territories. The three factors which made it necessary for Italy to define her boundaries were: Abyssinian expansion in the hinterland of Benadir; the Anglo-French-Italian accord of 13th December 1906; and the Anglo-Ethiopian agreement for delimitation of last February. With regard to Somaliland, the present agreement confirms to Italy the effective control of Lugh and Dolo on the Juba, two important trade centres, also adds to what she previously held, the tract of territory between Bardera and Dolo on the Juba, and the Webi Shebeli, a district

of over 50,000 square kilometres—in other words, twice the size of Sicily.

In Dankalia the results, if not so brilliant, make at any rate for security. Italy has had to give up certain of her ambitions. It was easy to agree to the demarcation of the limit of 60 kilometres from the coast which had been previously determined upon, and this is to be done. The difficulty arose in connection with the Salt Plains. The product of these plains forms the chief source of the currency of the country, and as Abyssinia resolutely insisted on retaining so valuable a territory, Italy wisely came into line. During all the negotiations, the Italian ministry has shown great moderation and fairness, and has secured considerable solid advantages.

The *Corriere della Sera* for 19th July contains an account of an expedition made along the Webi Shebeli with the object of ascertaining its navigability for commerce. The Webi Shebeli in its lower reaches runs more or less parallel to the coast-line, and apparently loses itself eventually in a series of marshes near the Juba. The communication with the outside world must therefore be by overland portage. It is found that the river in the region examined has an average depth in the centre of 1.60 to 1.80 metres, in some few places being as low as 1.10 metres. At the sides the depth is much the same, the contour of the river bottom being like that of a canal. The average width is 15 to 20 metres. These measurements were taken in April, when the river is at its lowest. There is, here and there, considerable growth of reeds, but this is not considered a serious difficulty. On the whole, it is thought that the river can be made navigable for motor boats of light draught, probably during the whole course up to the Abyssinian frontier, and that with a light railway running from the coast to a given point on the river, a valuable trade route could be established.

Irrigation in the Transvaal.—The report of the Inter-Colonial Irrigation Commission, which was appointed by Lord Milner in 1905, has now been published. The report deals with the subject of Irrigation in both the Transvaal and Orange River Colonies. The rivers in the Transvaal show, in one respect, a marked difference from those of the Orange River Colony. In the former Colony most of the large streams are fed from the dolomite formation; in the latter no dolomite has been found, and all the rivers, without exception, rise either in the Drakensberg or along the foothills of the Basutoland mountains. The Transvaal in its physical characteristics cannot be said to be a country eminently adapted for irrigation; a large proportion of the area is at a high elevation and is drained by comparatively short rivers which ultimately find their way into the Indian Ocean, and the valleys are generally restricted in width and are broken up by numerous rolling ridges. The great physical disadvantage of the country from the point of view of irrigation is the absence of extensive alluvial plains along the rivers. In the Orange River Colony there are important perennial rivers which afford opportunities for the extensive development of irrigation. The flood discharge from every river in this Colony flows into the Orange River which

empties into the Atlantic. The Commission recommends that, for purposes of irrigation administration, the two colonies should be divided into hydrographic districts, bounded by the main watersheds. Systematic observations of the rainfall in both colonies are of comparatively recent date, but during the last five years no less than 170 stations have been established in the Orange River Colony and a large number in the Transvaal. The statistics which have been collected are too incomplete and scanty to afford definite information, but, so far as they go, they do not justify the conclusion, which has been expressed, that the country is drying up. The Commission, however, with the view of preventing any reduction in the annual rainfall, give a word of warning concerning the evil effects which are believed to follow the destruction of forests, and concerning the evil of velt burning, which, while it does provide a supply of young grass, is believed to be a potent factor in the reduction of the water produced by springs. The Commission propose the formation of a River Board for each hydrographic district and a separate Irrigation Board to deal with works which may be constructed; they also favour the establishment of Water Courts to be, if possible, independent of the River Boards, which should deal primarily with all disputes concerning water rights. The Commission advises that Government should encourage irrigation by private enterprise, by retaining skilled irrigation engineers whose duty it should be to travel throughout the country and advise and assist farmers. The Commission discusses various projects for the utilisation of the available waters and is disposed to favour small rather than large undertakings, as it accepts the opinion that the country is not yet ripe for larger projects. Small works, it is pointed out, can in many instances be constructed by the farmers themselves, especially if the encouragement and practical advice of the Government engineers is granted to them.

Physiography of Western Liberia.—Mr. Parkinson gave some account of the structure of Liberia to the Geological Society recently, and his paper is printed in the *Quarterly Journal* of the Society (lxiv. 2). He shows that the main feature of Western Liberia is the low-lying character of the country, the very gradual rise northward from the shore-level to at least the latitude of Marakorri (about 7° 13′ N. lat.), and in relation to these the mature character of the Lofa, St. Paul, Mahé, Burror, and Junk rivers. Over the part of its course visited by the author the fall of the St. Paul is only about ten feet per mile—that is, from Millsburg to Burukai, a distance of nearly seventy miles, along which waterfalls, as distinct from rapids, are rare. The main streams and their tributaries at least approximate in grade, but in one observed instance, where the Tuma falls into the St. Paul, remnants of a hanging valley are to be seen. Alluvial flats raised above flood-level are conspicuous in many river-valleys. Flat-topped ridges and isolated hills, trending parallel to the foliation of the constituent gneiss, are characteristic of the country round Sanoyei and Boporo. At Boporo, according to the author, the successive ridges forming the outlying spurs of the Po Range are very suggestive of successive terraces of marine denudation.

A submergence of 700 feet would cover the southern part of Western Liberia with water almost as far north as 6° 50′ N. lat. Throughout there is a striking absence of late deposits in the form of old gravels and sands.

In the discussion that followed, Dr. J. W. Evans commented on the comparative rarity of hanging valleys in the tropics at low altitudes, where glacial conditions could not have effected the character of the erosion. While admitting that the hanging valleys of the west coast of tropical Africa might be accounted for by the rejuvenation of the main streams due to the rise of the land relatively to the sea, he thought that they might be the result of local variations in the rainfall at a time when (as was not improbably the case) this region was less well-watered than at present. In reply, the author stated that he favoured the idea that the hanging valleys were due to rejuvenation rather than to variations in rainfall, but no certain conclusion could be reached without further investigation.

Polar.

Outfit for Polar Expeditions.—In the *Bulletin* of the American Geographical Society for April there is a very interesting paper by Mr. V. Stefansson, of the Anglo-American Polar Expedition. The essence of the argument may be stated thus. It is Mr. Stefansson's opinion that many Polar expeditions fail on account of a too elaborate and costly equipment, and that in most the expeditions are needlessly costly. In his opinion Arctic explorers especially have not been sufficiently mindful of the geographical fact that the very circumstance that the Eskimos can rear their children in the Arctic climate shows that their modes of life are well adapted for the climate, and it should therefore be the explorer's object to imitate those methods as far as possible. In Arctic America, he states, there is a popular saying, "Look out for the man with one blanket." Being interpreted, this means that it is the man who travels light that goes far, but so far scientific explorers have shown reluctance to trust themselves to the one blanket. Commander Peary's success in Arctic travel has, Mr. Stefansson believes, been largely due to his imitation of Eskimo methods, but the expense of his expeditions has been high because he has approached the north from Greenland, and the cost of men and ships to get within striking distance is great. But in the Canadian Arctic many little-known shores can be reached at small outlay by means of whalers, and Mr. Stefansson believes that active, hardy young men, not afraid to live as the Eskimo do, could spend some time in the Arctic at very small expense, and bring back notebooks and maps of value. Some details are given in the paper as to exact methods, and the author is certainly well qualified to speak on the subject.

Expedition to Spitsbergen.—In our May issue (p. 266) we noted the despatch of a research party, under Professor Gerard de Geer, to Spitsbergen during the present summer by the Swedish Government. This expedition returned safely in September, after, it is stated, the

accomplishment of some valuable work in relation to the geography, geology, biology, and hydrography of the islands.

Commercial Geography.

The Fisheries of Alaska.—According to the U.S.A. Government Report on the Fisheries of Alaska (*Bureau of Fisheries Document*, 632), 12,752 persons were employed in connection with the fisheries of Alaska during the year 1907. Of these 4829 were employed in actual fishing, 7277 in the canneries and other shore work, and the remainder in transportation. In the official list the persons employed are classified as Whites, Indians, Japanese, and Chinese, but the last are only employed as shoresmen. Whites predominate in fishing and transporting. The invested capital in the fisheries amounted to about 9,200,000 dollars, and the total value of the products obtained during the year is estimated at 10,160,000 dollars approximately. The principal elements in the total yield are salmon, cod, and halibut. By far the greater part of the product is sent to external markets, but there is a small though steadily increasing local demand. An interesting geographical point is that of the market for the cod. Hitherto much of the output has been sent to the West Indies, but it cannot compete there on favourable terms with Atlantic cod because the method of curing is not such as to fit the product for the hot climate of the region. An effort is being made, on the one hand, to alter the curing methods, and on the other to tap a new market on the Pacific coast and in the great Middle West. But the great abundance of meat, and its consequent predominance as an article of diet in these districts, is making this a slow process. The headquarters of the cod industry are at San Francisco, Seattle, and Tacoma, but the firms engaged have also shore stations in Central Alaska.

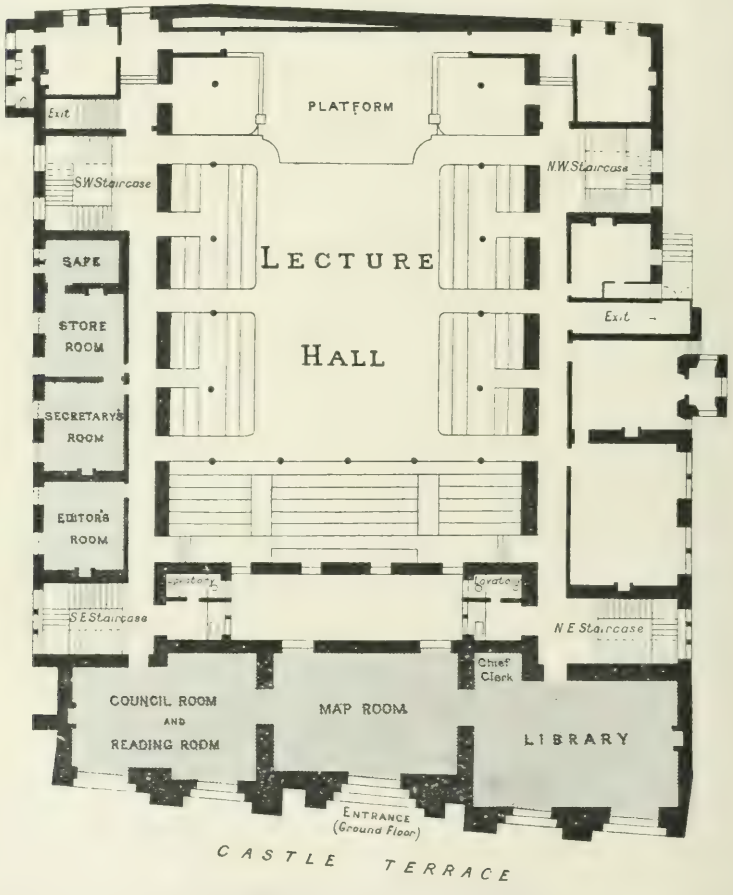
The report includes also some notes on furs. The sea-otter is definitely doomed, and it is apparently a question of a few years only before it utterly disappears. As regards the fur-seal, the fact that Japan is not bound by the agreement between Great Britain and the States is bringing about the curious result that not only are the Japanese actively engaged in sealing, but also that British Columbian boats are registering under the Japanese flag. The result will again probably be the disappearance of the fur-seal with the sea-otter.

General.

Peru and Standard Time.—According to a note in *Science*, on July 28 the time of the seventy-fifth meridian west of Greenwich was adopted by Peru as the national standard time for the whole of that country. This meridian is only a few minutes from that of Lima, and runs almost directly through the middle of the country. All timepieces in Peru will now coincide with these in the United States where eastern time is kept. Peru is the first South American Republic to adopt the world standard.

Prince Roland Buonaparte's Fund.—In our May issue (p. 266) we noted the foundation of a fund by Prince Roland Buonaparte for the encouragement of scientific research, which was placed at the disposal of the Paris Academy of Sciences. The awards for 1908 from this fund have been recently announced, and we note some of geographical interest. Thus M. Colin obtains a grant of 3000 francs for the publication of a map of South Imerina (Madagascar), and M. Dongier 2000 francs for the establishment of apparatus for the simultaneous study of the rainfall and atmospheric potential, while other grants are made for astronomical instruments in connection with different observatories.

The Society's New Rooms.—The accompanying plan and photographs show the position and nature of the Society's new rooms. The



The Society's special rooms are tinted grey.

public rooms consist of a Library, a Map Room, and a Council Room which

The Library.

when not required for meetings is available as a Reading Room for members, and is fitted up with writing materials for their use The

The Map Room with Council Room beyond.

hours of opening are the same as before; but a proposal is under consideration to open the rooms one evening a week, for the benefit of teachers and others who may find it difficult to take advantage of the resources of the Library during the day.

EDUCATIONAL.

In our May issue (p. 268) we gave a brief account of Professor Davis's projected excursion to Northern Italy and the Alps, to be held in June and July last. In *La Géographie* for August 15 there appears a note summarising the actual course of the excursion as it was carried out. Thus in the north-eastern border of the Apennines the party studied the valleys near Faenza which afford a proof of the general elevation of the surface in this region; in the Mediterranean region between Pisa, Spezia, and Genoa the general method of study of geomorphogenic processes in littoral regions was investigated, and in the upper valleys of the Po and the Tanaro the phenomenon of river capture; the glacial valleys and lakes of the border of the Alps, their hanging valleys, and the terminal moraines of the ancient glaciers were examined in the vicinity of Como, Lugano, and Maggiore, as well as

the valleys without lakes found in the Dora Baltea and the morainic amphitheatre of Ivrea. Subsequently Professor Davis entered France and made a series of excursions in the Alps round about Grenoble, the Vercors and the Cevennes, being accompanied in this part of the tour by Professor W. Kilian of Grenoble, Professor Emm. de Martonne of Lyons, their pupils and members of the Lyons Geographical Society. The method which Professor Davis followed throughout was to consider in every case, first, the structure of any given geographical form; second, the way in which it has arisen; third, the stage of evolution to which it has attained; and, finally, if circumstances permit, the cycle of erosion to which it belongs.

In the same issue of *La Géographie* there is a report on the fourth French Inter-University Geographical Excursion, which took place from June 5 to 10 this year, and was devoted to the north of France, especially Flanders and the Boulonnais. The report is sufficiently full to make the course of the excursion clear, and an abstract may, we think, be useful. An interesting feature was that, conducted by M. Demangeon of Lille, the party included students from Paris, Lille, Lyons, Rennes, Bordeaux, Nancy, as well as professors from several of these universities. This admixture of students from different parts of France, and the participation of their teachers, cannot but serve as a stimulus to geographical teaching in France, and is a feature which might well be imitated.

The party started from Lille and descended at Bailleul, where they found themselves in the middle of the Flemish plain, with its trees and its hop-gardens, its pastures and its small holdings. Thence an ascent of the hills of the region was made, and their origin as remnants of a very ancient *cuesta* explained. The points of contrast between the life of the hill inhabitants and of those of the plain, with the geographical reasons for this, were also investigated. Hence an ascent of the heights of Artois was made, *via* St. Omer, and it was seen how the scarcity of water, due to the chalky soil, produced here groups of villages. Again, the vicinity of mines and of industrial centres gives capital, and the consequence is the establishment of relatively large farms, worked by means of modern machinery, and thus in marked contrast to the primitive mechanism of the Flemish farms. A large farm was visited to emphasise this point, and it was noted that in addition to an intensive culture of cereals and sugar beet, the dairying industry was largely practised. The survey was not however confined to economic geography, for the elevated position permitted an admirable view of the plain to be obtained, and this was subsequently studied and the phenomenon of river capture investigated in a very striking example on the course of the Aa. A day was then given to the study of the Bas-Boulonnais, whose humid plains are devoted especially to horse-rearing. Here again a farm was visited to make clear the special conditions. A visit was then paid to the vicinity of Dunkerque to study first the shore-line, and subsequently the port. To the west of Dunkerque the shore is increasing, and a visit was paid to a farm placed on recently reclaimed land, the fact being noted that the reclaimed land of the maritime plain, which requires constant

care and protection, is exploited by large holders, while in the neighbouring dunes there occur on the contrary very small plots whose inhabitants live on the products of the fisheries and by the cultivation of market-garden produce. Dunkerque was carefully studied, both in its present condition and by the aid of old maps, from the standpoint of its development. On the following day a visit was paid to Boulogne, to note the contrast between this port and Dunkerque, the latter having for its function the supplying of the industrial north, while the other from its position is a passenger and mail station, exports early fruit and vegetables to England, but owes its prosperity especially to its fish trade, now fully industrialised. Here, as apparently everywhere, the party had expert local guidance, in the person here of the director of the Marine Fishery Station at Boulogne. The last three days were devoted to a study of the coast from Sangatte to Boulogne, and from Saint Valéry to Le Tréport, various phenomena of physical geography being studied *en route*.

From the summary it would appear that the whole excursion was so arranged as to afford an excellent idea of the main facts of physical and human geography, and the account given above may be useful as serving to suggest to others suitable forms of excursion for junior students.

NEW BOOKS.

EUROPE.

By the Roman Wall: Notes on a Summer Holiday. By Maria A. Hoyer. With Illustrations from Sketches and Photographs by the Author. London: David Nutt, 1908. *Price 2s. 6d. net.*

This is a sketchy little account of a journey along Hadrian's Wall, accompanied by a moderately good map. The text is somewhat needlessly spun out by the insertion of a number of trifling details, chiefly relating to meals, but the author is obviously an enthusiast, and shows a real appreciation of the Northumbrian scenery along the line of the wall. The book will doubtless be of value in calling attention to the attractions of the region.

ASIA.

Selections from the Travels and Journals preserved in the Bombay Secretariat. Edited by George W. Forrest, C.I.E., Ex-Director of Records, Government of India. Bombay, 1906. *Price Rs. 7 or 10s. 6d.*

Unquestionably the Ex-Director of Indian Records did well to rescue these narratives from the pigeon-holes and oblivion of the record room of the Bombay Secretariat. It is true that now they are all ancient history, dating from 1826 to 1843, but not the less are they full of interest and instruction. Sir Thomas Holdich, an expert whose authority will not be disputed, has said of them, "They are all of them most valuable, although there is hardly any part of the regions dealt with that has not been recently either explored thoroughly or actually surveyed." What cannot fail to strike the reader is the simplicity of style, the

truthfulness of the narratives, and the unconsciousness of the writers that they had been doing anything which compels our admiration for their courage, devotion and self-sacrifice. The style especially is often a delightful contrast to what we are accustomed to find in official reports. Take for example the last of the selections, the narrative of a journey to Shoa, *i.e.* Southern Abyssinia. The journal submitted by a Lieutenant of the Indian Navy to Government begins thus :—

> "'I had heard of battles and I longed
> To follow to the field some warlike lord.'
>
> *Douglas*, by HOME.

"A similar feeling induced me to give up the command of the *Euphrates* (a ten-gun brig) and to accompany the party, under Major Harris of the Bombay Engineers, proceeding through the wild deserts of the Dantiali to the court of the Christian King of Shoa with costly presents from the Indian Government. Never shall I forget the feelings with which I, for the first time after a period of nearly thirteen years uninterrupted service, found myself freed from that strict restraint so necessary in naval service. I indeed felt free! But little did I then think of all the dangers, the difficulties we had to encounter in crossing perhaps the most inhospitable desert on the face of the earth, exposed during the day to the scorching rays of a tropical sun, and at night to the lurking crease of the midnight assassin. Verily part of the prophecy has been fully carried out in these wild sons of the desert, for their hand is indeed against every man."

The greater part of the selections refer to expeditions and journeys in Afghanistan and the Punjab in the days of Shah Kamran and Runjeet Singh, and among them, if we had to make a choice, we would choose the journals of the American adventurer Masson, as most likely to rivet the attention of our readers, even although some of the narratives are the work of D'Arcy Todd, Captain A. Burnes, and Eldred Pottinger, names the mere mention of which indicates the wealth of historical interest which awaits the reader.

The Marches of the Mantze. By J. H. EDGAR, China Inland Mission. London, Philadelphia, Toronto, Melbourne, and Shanghai: Morgan and Scott, Limited.

The Marches of the Mantze is a tract of territory, somewhat less in size than the whole of Scotland, situated on the west of the Chinese province of Sze-chuan and adjoining Tibet. It is inhabited by various turbulent and semi-civilised Tibetan tribes, who claim to be, and more or less *de facto* are, independent, but both the Government of Pekin on the one side, and that of Lhasa on the other, claim their allegiance and obedience with the usual unhappy results, viz., that the unfortunate inhabitants of the tract are plagued and harassed by both Governments, and obey in a half-hearted and dubious fashion whichever Government shows for the time being the stronger hand. According to the author of this interesting little book the Government of Pekin for the present at any rate has got the better of the Lamas, and there are numerous indications of the presence of a fairly strong and resolute administration; but how long this is to last is quite problematical. The author of this monograph is a missionary who has spent some years in this tract, and has evidently studied the people and explored the country to some purpose. The booklet contains a series of graphic sketches, historical and descriptive, which indicate that the writer is capable of much more elaborate and exhaustive treatment of a subject, on which we have at present very little information.

AUSTRALASIA.

New Zealand at Home. By the Hon. R. A. Loughnan, M.L.C. London: George Newnes, Limited. *5s. net.*

New Zealand at Home is one of a series Messrs. Newnes are issuing in connection with various countries. If all the volumes are executed with the fulness and care with which this work is done, it will prove a valuable issue. New Zealand has been reclaimed from the wilderness within the past sixty years, and it has made remarkable strides. The Maori, one of the finest of native races, has agreed to share the country with the Anglo-Celt; and every care is now taken to allow him to live and to work out his destiny. The latest return shows a remarkable increase in the population of the tribe—in 1896 it was 39,000, in 1906 it was 47,731. In this work the author, in his twenty-one chapters, deals with the population, the country, the division of wealth, town life, country life, religious life, sports and pastimes, literature and the press, education and labour, etc. The political system has developed rapidly, and is certainly to-day one of the most comprehensive. Old age pensions of ten shillings per week are given to all who are too poor to maintain themselves. A limit is practically set upon all incomes above £2000 a year. Women enjoy the franchise. Labour laws forbid strikes. Mr. Loughnan writes with lucidity and zest, and presents an admirable account of life in our distant colony. Sometimes in his historical references, one could wish a few dates had been added. But a serious drawback to the book is the lack of an accompanying map. In perusing a work of this kind, one has not always an atlas at hand. And as the work is not intended for New Zealanders at home but for those far away from the country, a map is simply indispensable.

GENERAL.

Leitfaden der Kartenentwurfslehre für Studierende der Erdkunde und deren Lehrer. Bearbeitet von Prof. Dr. Karl Zöppritz. In zweiter neubearbeiteter und erweiterter Auflage herausgegeben von Dr. Alois Bludau. Zweiter Teil: Kartographie und Kartometrie. Leipzig: Druck und Verlag von B. G. Teubner, 1908. Pp. 109. *Price M.* 3.60; *cloth M.* 4.40.

This small volume is the companion of the first part of the work, which appeared in 1899, and deals with map projections. It treats of the subjects usually found in the latter part of works of this kind—the various kinds of topographical and geographical maps, the representation of surface features, contour lines, hatchings and other methods of indicating the relief of the land, lettering, etc. While many authors, however, content themselves with giving a general statement of the methods employed, Dr. Bludau explains them with great detail and exactness, his aim being that the student of his book shall be able to produce a map ready for the hands of the engraver. Thus in the representation of the relief by hatchings he shows how the density can be calculated for each angle of elevation, and according to the system adopted. Even for the construction of the network from the calculated co-ordinates, and the adaptation of the scale to the size of the sheet, full instruction is given, which will doubtless be a help to the tyro in cartography, though, if he have enough mathematical knowledge to understand the theory of map projections, he should not find much difficulty in these matters. An unusual and very useful feature is a section on cartometry, in which directions are given for the measurement of angles, distances and areas by calculation and by the use of instruments such as planimeters, millimetre sheets,

etc. Illustrations of the marks which are used to indicate roads, railways, bridges, and also forests, swamps, deserts and other surface features would have rendered the work more complete. These signs can, indeed, be learned from maps, but so also can lettering, to which considerable space is devoted. All that is necessary for the geographical student will be found in this little volume, which is one of the best of its kind.

BOOKS RECEIVED.

We have received the following books and reports :—

National Antarctic Expedition, 1901-1904. Physical Observations, with discussions by various authors. Prepared under the Superintendence of the Royal Society. Pp. vi + 192. London : Royal Society, 1908.

The A.L. Senior Geography for Scottish Schools : Being Outlines of Geography for the Higher Classes. With 14 Maps and 4 Diagrams. By THOMAS PAGE. Crown 8vo. Pp. 192. Leeds : E. J. Arnold, 1908.

Corsica : an Island of Rest. By JOHN MITCHELL CHAPMAN. Demy 8vo. Pp. xii + 380. *Price* 7*s.* 6*d. net.* London : Edward Stanford, 1908.

The Face of the Earth (Das Antlitz der Erde). By EDUARD SUESS. Translated by Hertha B. C. Sollas, under the direction of W. J. Sollas. Volume III. Royal 8vo. Pp. viii + 400. *Price* 18*s. net.* Oxford : Clarendon Press, 1908.

Scandinavian Britain. By W. G. COLLINGWOOD, M.A., F.S.A. With chapters introductory to the subject by the late F. York Powell, M.A. Crown 8vo. Pp. 272. *Price* 3*s.* 6*d.* London : Society for Promoting Christian Knowledge, 1908.

The Greatness and Decline of Rome. Volume III. *The Fall of an Aristocracy.* By GUGLIELMO FERRERO. Translated by Rev. H. J. Chaytor, M.A. Demy 8vo. Pp. 342. *Price* 6*s. net.* London : William Heinemann, 1908.

Thirty-five Years in the Punjab, 1858-1893. By G. R. ELSMIE, C.S.I., LL.D. Demy 8vo. Pp. xviii + 386. *Price* 9*s. net.* Edinburgh : David Douglas, 1908.

Hindustani Self-Taught with English Phonetic Pronunciation. By Captain C. A. THIMM. Third Edition. Crown 8vo. Pp. 112. *Price* 2*s.* 6*d.* London : E. Marlborough and Co., 1908.

Practical Geography. By FREDERICK MORT, M.A., B.Sc., F.G.S. 4to. Pp. 70. London : Blackie and Son, 1908.

The Baganda at Home. With one hundred pictures of life and work in Uganda. By O. W. HATTERSLEY, C.M.G., Secretary, Board of Education, Uganda. Demy 8vo. Pp. xvi + 227. *Price* 5*s. net.* London : Religious Tract Society, 1908.

The Physics of Earthquake Phenomena. By CARGILL GILSTON KNOTT, D.Sc., F.R.S.E., etc. Demy 8vo. Pp. xii + 282. *Price* 14*s. net.* With many diagrams. Oxford : Clarendon Press, 1908.

A Rational Geography. By ERNEST YOUNG, B.Sc. Part III. Crown 8vo. Pp. x + 213. *Price* 1*s.* 6*d.* London : George Philip and Son, 1908.

La Roumanie, 1866-1906. Large Demy. Pp. viii + 493. Bukarest : Ministère de l'Agriculture, de l'Industrie, du Commerce et des Douanes.

The "Contour" Road Book of Ireland. From special surveys by HARRY R. G. INGLIS. 500 Maps and Plans. $6\frac{1}{4} \times 3\frac{5}{8}$. Pp. xvi + 254. *Price* 2*s. net.* London : Gall and Inglis, 1908.

To the Top of the Continent: Discovery, Exploration, and Adventure in Sub-Arctic Alaska: The First Ascent of Mount M'Kinley, 1903-1906. By FREDERICK A. COOK, M.D. Royal 8vo. Pp. xxi + 320. *Price* 12*s. net.* London: Hodder and Stoughton, 1908.

Canada's Fertile Northland: A Glimpse of the Enormous Resources of part of the Unexplored Regions of the Dominion. Edited by Captain ERNEST J. CHAMBERS. Large Demy. Pp. 139. With volume containing Maps. Ottawa: Government Printing Bureau, 1908.

The Student's Geography. Eighth Edition. By GEORGE GILL, F.R.G.S. With over 200 Maps and Diagrams. Demy 8vo. Pp. 1000. *Price* 4*s.* 6*d.* London: George Gill and Son, Limited, 1908.

Preparation Papers in Geography. Oxford and Cambridge Local Examination for Junior, Senior, and Preliminary Candidates. 3 Parts. Crown 8vo. *Price* 4*d. each.* London: George Gill and Son, Limited, 1908.

Through Southern Mexico: Being an Account of the Travels of a Naturalist. By HANS GADOW, M.A., Ph.D., F.R.S. Large Demy 8vo. Pp. xvi + 527. *Price* 18*s. net.* London: Wetherby and Co., 1908.

New Zealand. By REGINALD HORSLEY. With 12 Illustrations in Colour from Drawings by A. D. Cormack, R.I. (Romance of Empire Series.) Demy 8vo. Pp. xiii + 331. *Price* 6*s. net.* London: T. C. and E. C. Jack, 1908.

Things Seen in China. By J. R. CHITTY. Small 4to. Pp. xii + 252. *Price* 2*s. net.* London: Seeley and Co., Limited, 1908.

On the Coromandel Coast. By F. E. PENNY. Small Demy 8vo. Pp. vi + 358. *Price* 10*s.* 6*d. net.* London: Smith, Elder and Co., 1908.

Venetia and Northern Italy: Being the Story of Venice, Lombardy and Emilia. By CECIL HEADLAM. Illustrated by Gordon Home. Square Medium 8vo. Pp. xiv + 347. *Price* 7*s.* 6*d. net.* London: J. M. Dent and Co., 1908.

Handbuch der Klimatologie. Von Dr. JULIUS HANN. Band I. Allgemeine Klimalehre. Demy 8vo. Pp. xiv + 394. *Preis* 13 *M.* Stuttgart: J. Engelhorn, 1908.

Proceedings of the Royal Colonial Institute. Volume XXXIX., 1907-1908. London: The Institute, 1908.

British Rainfall, 1907. By HUGH ROBERT MILL. Volume XLVII. London: Edward Stanford, 1908.

Die Volksdichte im Kreise Melsungen und die sie hauptsächlich bedingenden Faktoren. Von JOHANNES SCHMIDT. Pp. 81. Cassel, 1907.

The Surveys of British South Africa, Ceylon, and the Federated Malay States. Annual Report of the Colonial Survey Committee. London, 1908.

Central Provinces District Gazetteers. Edited by R. V. RUSSELL, I.C.S. Bhandara and Chhindwara Districts. Allahabad, 1908.

Madras District Gazetteer. By F. R. HEMINGWAY. Godavari District. Madras, 1908.

Bengal District Gazetteer. By L. S. S. O'MALLEY. Angul and Saran Districts. Calcutta, 1908.

Publishers forwarding books for review will greatly oblige by marking the **price** *in clear figures, especially in the case of foreign books.*

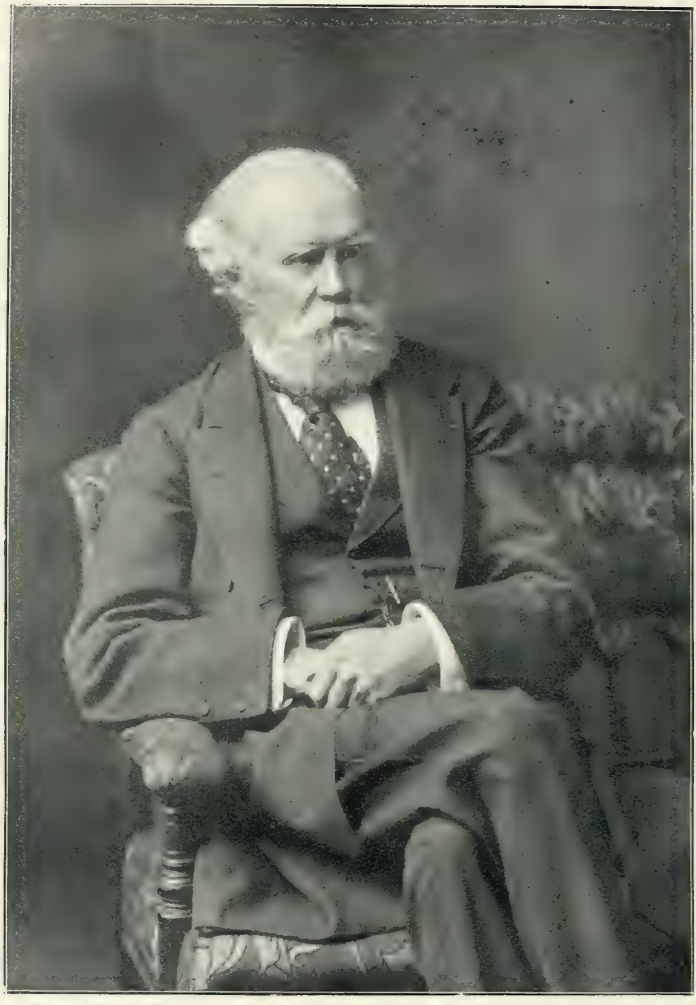


Photo by Dickinson.

Aubrey

THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE SCENERY OF SWITZERLAND.[1]

By the Right Hon. Lord Avebury, D.C.L., LL.D., F.R.S.

(With Portrait.)

The Scenery of Switzerland, on which your Council have invited me to address you this evening, is a subject so interesting, and at the same time so complex, that after a very few and very hearty words, to express my sense of the honour you have done me, I am sure I shall consult your wishes in entering at once on my theme.

No one need apologise for speaking on Geology to a Scotch audience, and it is impossible to understand the scenery of Switzerland, or indeed of any other country, without some reference to Geology.

We sometimes hear people say, "Oh, I know such a hill, or such a river well. I lived in sight of it all my life." But it does not follow that they know it. They know the outline perhaps, and the trees and fields. But these are merely the surface. What is there below? What has been the history? As my friend Professor Theobald truly said, "We do not really know a mountain until its interior is to our mental eye as clear as crystal."

In the following short epitome of Swiss geology I follow mainly the authority of my distinguished friend, Professor Heim of Zurich.

Igneous Rocks.

To commence with the Igneous series, which come from the fiery heart of the earth, Gneiss, which, in Switzerland as elsewhere, is the fundamental rock, forms in great part the central ranges, reappearing also here and there in other parts, as for instance on the Rhine at Laufen, and would, it is thought, be found everywhere if we could penetrate deep enough.

[1] A Lecture delivered before the Society at Edinburgh, November 19, 1908.

Granite, like Gneiss, is composed of Quartz, Felspar, and Mica, but differs in not being foliated.

Like Gneiss it must have solidified under great pressure, and therefore at a great depth. In the first place, the crystals it contains could not have been formed unless the process of cooling had been very slow.

Over the Gneiss lie immense masses of Crystalline Schists, several thousand feet in thickness. No fossils have been found in them, though the presence of Graphite and seams of Limestone have been supposed to indicate the existence of vegetable and animal life. The more ancient were perhaps deposited while the waters of the ocean were still at a high temperature. So generally distributed are these Schists, that, in the opinion of many Geologists, they everywhere underlie the other stratified formations as a general platform or foundation. In parts of Switzerland, however, more recent sedimentary strata have been so much modified by pressure, and in many cases by heat, that it is very difficult, and even in places impossible, to distinguish them from the older Crystalline Schists.

The earliest fossiliferous rocks which occur in Switzerland belong to the age of the Coal Measures. They generally occur in narrow strips, which probably were protected from denudation by having been valleys. It is probable that after the Carboniferous period the country was raised up, and a former range of mountains occupied the site of the present Alps. The Carboniferous Puddingstone of Valorsine, which contains well-rounded pebbles and boulders, shows that there must have been mountains and rapid rivers at this period.

These ancient mountains, however, were removed by denudation, and the whole country sunk below the sea.

Then came a succession of marine sedimentary deposits corresponding to our Trias and Lias, Chalk, and early Tertiaries—such as the London Clay, and indicating an enormous period, during which that part of the earth's surface was several times submerged for long ages, sometimes to great depths—and thousands of feet of strata were deposited. Wherever the Gneiss or Crystalline Schists come to the surface, as over a great part of Switzerland and on the tops of many of the mountains, as for instance Mont Blanc, the Jungfrau, the Matterhorn, and many others, these sedimentary strata, which must have taken millions of years to form, have been again removed.

At length we come to the comparatively recent Pliocene period, which is still very long ago, if time is measured in years.

The remains of this age in our islands are confined to the south and east—occurring especially in Norfolk and Suffolk. The north of England and the whole of Scotland appear to have been already dry land. At any rate if any part was submerged, no clear evidence now remains.

Switzerland also was at this period gradually raised above the sea, though this penetrated up some of the northern valleys of Lombardy.

The Swiss mountains, therefore, if so imposing by their height, cannot be compared to those of England and Scotland in point of age, which, if comparatively so low, are venerable from their immense antiquity.

If one examines the Alps from some vantage ground, the profile of the horizon assumes innumerable forms: towers, domes, cupolas, cones, arches, ridges, pyramids, obelisks, spires, teeth and pinnacles. The Weisshorn is a sharp pinnacle, Mont Blanc is a cupola, Mont Rosa a series of sharp-pointed cones.

In fact no two mountain tops are alike, and most of them present very different forms according to the direction from which they are seen.

But how were the mountains formed? The true mountain ranges, that is to say, the elevated portions of the earth's surface, are the continents themselves, on which most mountain chains are mere wrinkles; nevertheless when we speak of mountains, we mean as a rule those parts of the land which stand high relatively to the sea-level. To what then are these mountain ranges due? On this subject I must warn you that geologists are not altogether agreed. I can only lay before you the explanation which seems to me most probable.

Mountain ranges in this sense may be classed under two main heads, viz.:—

1. Table mountains.
2. Folded mountains.

The highest points or peaks may be again divided into two classes—volcanoes; and those due to weathering.

Volcanoes have had comparatively little effect on the scenery of Switzerland. There is only one group of hills in the neighbourhood of Switzerland, those of Hohgau near the Lake of Constance, which is of volcanic origin.

Mountains again may be divided into primary and secondary mountains—those due to elevation, and those due to denudation.

Let us imagine a country raised above the water with a gradual and uniform slope towards the sea. Rivers would soon establish themselves, guided by any inequalities of the surface, and running at more or less equal intervals down to the water level. They would form valleys, down the sides of which secondary rivulets would flow into the main streams. The rain and frost would denude with especial rapidity those parts of the surface which offered the least effective resistance, and thus not only would the original watershed be cut into detached summits, but secondary ridges would be formed approximately at right angles, to be again cut into detached summits like the first.

The rapidity of denundation is of course affected greatly by the character of the strata, so that the present level depends partly on the original configuration, partly on the relative destructibility of the rock, and on the pebbles carried down by the river. The existing summits are not those which were originally raised the highest, but those which have suffered the least. And hence it is that so many of the peaks stand at about the same level. Every one who has ever stood at the top of such a mountain as the Piz Languard, which I name as being so easily accessible and so often visited, must have been struck by this fact; and must have noticed that the valleys are a far less important part of the whole district than they seem when we are below. The Matterhorn is obviously a remnant of an ancient ridge, which gives the

peculiar straight line at the summit. The noble mass of the Bietschhorn, again, which forms such an imposing object as we look down the valley of St. Niklaus across the Rhone at Visp, is a part of the surrounding granite which has resisted attack more successfully, or been more recently attacked than the rest of the rock. The mountain crests, solid as they look from a distance, are, as a rule, covered by detached fragments, shattered by storms, and especially by frost.

At present the summits of the central chain consist of the very ancient crystalline rocks, but there can be no doubt that an enormous thickness of sedimentary strata formerly extended over them. It is a common error to suppose that the limits of geological strata are those which are now shown on the map. It requires little reflection, however, to show that this is not so. In the abyssal depths of the ocean, deposit is portentously slow, and a long period would be represented by a few inches of rock. Moreover, though a marine formation proves the existence of sea, the absence of a marine formation does not prove the existence of land. Strata may and often have been entirely removed. Our Cretaceous deposits, for instance, once extended far beyond their present limits. The same was the case with the Secondary deposits of Switzerland from the Coal Measures to the Eocene. They extended completely over the Central Mountains. If these mountains had been then in existence and the Secondary strata had been deposited round them, we should find evidence of shore deposits, with remains of animals and seaweeds such as live in shallow waters and near land. This is, however, not the case; we find no pebble beds such as would be the case near a shore, no gravels with pebbles of granite, gneiss, or crystalline schists, but deep-sea deposits of fine sediment evidently formed at some distance from land, and the southern shores of the Chalk Sea were perhaps far away in Africa. Even the Eocene deposits show no evidence of a shore where the Alps now rise above them.

We have other proofs that the Central Chains were formerly covered by other strata. For instance, the Puddingstone of Valorsine at the head of the Chamouni valley, which belongs to the Carboniferous period, contains no granite or porphyry pebbles. The granite and porphyry strata of the district must therefore at that period have been protected by a covering of other rocks which have been since stripped off.

It is also significant that the pebbles of the Miocene Nagelflue which forms so much of Central Switzerland, are mainly of Eocene age. Neither the Crystalline rocks nor the older Secondary strata seem to have been then as yet uncovered. There are indeed Crystalline and Triassic pebbles in the Nagelflue, for instance, of the Rigi, but they do not belong to rocks found in the valley of the Reuss or on the St. Gotthard. They resemble those of Lugano, Bormio, the Julier, and other districts far away to the south-east.

We are not, however, dependent on these arguments alone, conclusive as they are, for remains of Secondary strata occur here and there in the Central district, and these are not fragments torn away from

another, but parts of a formerly continuous sheet, which have been preserved in consequence of being protected in the hollows of deep folds. That the Secondary strata were once continuous over the Central chain is well shown in a section drawn from the Rhone to the Averserthal, and cutting the Binnenthal, Val Antigorio, Val Bavena, Val Maggia, Val Ticino, Val Blegno, Val Misocco, and Val St. Giacome. This section shows that all these valleys are primarily due to great folds, and that in each case we find at the bottom of the valleys remains of the Secondary strata nipped in between the Crystalline rocks.

Again, it is clear that a great thickness of Crystalline rock has been removed from the summit of Mont Blanc. No doubt many thousand feet had been removed before the deposition of the Secondary strata. But even since its elevation the amount of erosion of the Granite itself has been considerable. How much we do not know, but 500 metres would probably be a moderate estimate. To this must be added the Crystalline Schists, say 1000 metres, and the Sedimentary rocks, which, from what we know of their thickness elsewhere, cannot be taken at less than 3000 metres. This, therefore, gives 4500 metres, or say 14,000 feet, which erosion and denudation have stripped from the summits of the mountains.

As regards Mont Blanc, the final proof was due to M. Favre. On a memorable occasion, 12th August 1847, he ascended the Aiguille de Gliére. It was a splendid day, and he says: "I made a long halt on the summit, enjoying the glorious views. For some time I watched this majestic scene with inexpressible pleasure; but all of a sudden I remarked on the north-west, at the summit of one of the Aiguilles Rouges, a structure which suddenly carried me to another order of ideas —no less grand and no less lofty than the reverie into which the contemplation of the magnificent view had plunged me.

"I saw the Aiguilles Rouges formed by vertical layers of gneiss, but when I looked more closely the highest bore a sort of cap. This cap was formed by strata nearly horizontal, and resting on the vertical layers of gneiss which compose the body of the mountain. This observation absorbed all my attention. It was evident from the discordance between the horizontal and the vertical strata, that the 'cap' was of an entirely different nature from the 'aiguille' itself. In fact the 'cap' was formed of Jurassic strata and clearly showed that these once extended right over the summit of Mont Blanc."

What an enormous amount of denudation has already taken place is shown, for instance, in the mountain of Tremettaz, near the valley of the Rhone, between the Niremont and the Sarine, where it is evident, not only that the strata have been cut off, but that what is now the top of the mountain was once the bottom of a valley.

It used to be supposed that mountains were upheaved by forces acting more or less vertically from below upwards, and the igneous rocks which occupy the centre of mountain ranges were confidently appealed to in support of this view. It must be confessed that when we first visit a mountainous region, this theory seems rational and indeed almost self-evident. It is now, however, generally admitted that such an explana-

tion is untenable: that the igneous rocks were passive and not active; that, so far from having been the moving force which elevated the mountains, they have themselves been elevated, and that this took place long after their formation. Near the summit of the Windgälle, in the Reuss district, is, for instance, a mass of Porphyry. The eruption of this Porphyry must have taken place before the Jurassic period, for rolled pebbles of it occur in that rock. On the other hand, the fold on the summit of the Windgälle contains Eocene strata. The origin of the Porphyry then is earlier than the Jurassic; the elevation of the mountain is later than the Eocene. It is clear, therefore, that the Porphyry had nothing whatever to do with the origin of the Windgälle mountain.

The igneous rocks have, moreover, produced no effect on the strata which now rest on them. If, however, they had been intruded in a molten condition, they must have modified the rocks for some distance around. It is evident, therefore, that the igneous rocks had cooled down before the overlying strata were deposited.

How then were the mountains themselves raised above the azure main?

The explanation which commends itself to me connects it with the gradual contraction of the earth. It was once no doubt far hotter than at present—was once, in fact, an immense globe of incandescent vapour —and has gradually cooled down.

The present temperature of the Earth's surface is due to the Sun; that supplied from the original heat of the planet being practically imperceptible. The variations of temperature due to the seasons, etc., do not extend to a greater depth than about 10 metres. Beyond that we find as we descend into the earth that the heat increases on an average about 1° Fahr. for about every 70 metres. Even, therefore, at comparatively moderate depths the heat must be very great. Many geologists in consequence have been, and are, of opinion that the main mass of the earth consists of molten matter. We know, however, that the temperature at which fusion takes place is raised by pressure, and it must not, of course, be assumed that the temperature continues to increase so rapidly beyond a certain depth. Other great authorities, therefore, are of opinion that the mass of the earth, though intensely hot, is solid, with, no doubt, lakes of molten matter. In either case the central mass continues slowly to cool and consequently to contract. The crust, however, remains at the same temperature and consequently of the same dimensions. This being so, under the overwhelming force of gravity one of two things must happen. Either (1), parts of the crust must break off and sink below the rest; or (2), the surface must throw itself into folds.

Where the first alternative has happened we find more or less numerous faults.

Those parts which have not sunk, or which have sunk less than the rest, remain as tabular mountain masses, more or less carved into secondary hills and valleys by the action of rain and rivers. Such, for instance, is the Table Mountain of the Cape of Good Hope; its relative height is not due to upheaval, but to the surrounding districts having sunk.

As the crust of the earth cooled and solidified, certain portions "set," so to say, sooner than others; these form buttresses, as it were, against which the surrounding areas have been pressed by later movements. Such areas have been named by Suess "Horsts," a term which it may be useful to adopt, as we have no English equivalent.

But why are the strata thus thrown into folds? When an apple dries and shrivels in winter, the surface becomes covered with ridges. Or again, if we place some sheets of paper between two weights on a table, and then bring the weights nearer together, the paper will be crumpled up. In the same way let us take a section of the earth's surface A B and suppose that, by the gradual cooling and consequent contraction of the mass, A B sinks to A^1 B^1, then to A^2 B^2, and finally to A^3 B^3. Of course if the cooling of the surface and of the deeper portion were the same, then the strata between A and B would themselves contract, and might consequently still form a regular curve between A^3 and B^3. As a matter of fact, however, the strata at the surface of our globe have long since approached a constant temperature. Under these circumstances there would be no contraction of the strata between A and B corresponding to that in the interior, and consequently they could not lie flat between A^3 and B^3, but must be thrown into folds, commencing along any line of least resistance. Sometimes, indeed, the strata are completely inverted, and in other cases they have been squeezed for miles out of their original position. "The great mountain ranges," says Geikie, "may be looked upon as the crests of the great waves into which the crust of the earth has been thrown."

Other investigators have studied the effects of compression on layers of cloth, clay, etc. In these investigations the compression was from two sides only. If, however, folded mountains are caused by contraction due to the cooling of the earth, the compression must take place from all sides, and there must be two series of folds at right angles to one another. It is not very easy to illustrate this experimentally. Still I have been able to do so, and the results are published in the *Quarterly Journal* of the *London Geological Society*.

It has long been observed that in mountainous districts there are, as a rule, two sets of folds at right angles to one another, and it has generally been assumed that these were due to pressure in different directions and at different periods. In that case, there is no reason why they should be at right angles more than any other inclination. I have ventured to suggest, however, that if the foregoing explanation of mountain folds be correct, there must necessarily be two sets of flexures at right angles to one another, for if the area A B C D was compressed so as to occupy only the area A^1 B^1 C^1 D^1, the compression and consequent folding of the strata would not be in the direction of A B only, but also at right angles to it, in the direction A C, though the amount of the folding may be much greater in one direction than in the other. Thus, if the main folds run south-west and north-east, the subsidiary ones would be north-west and south-east.

These considerations, then, seem to account for the two main directions of cross valleys which occur in so many mountainous

regions, and suggest a reason for the sharp turns made by so many rivers.

Look, for instance, at the map of Scotland.

I doubt not that many of you have been by the Caledonian Canal—that remarkable glen due to a dislocation—which runs right athwart Scotland from SW. to NE. from Islay, past Colonsay up the Firth of Lorne between Mull and Oban, up Loch Linnhe, Loch Lochy, and Loch Ness, up the Moray Firth, and which, if you look at a larger map, you will see follows the eastern shores of the Orkneys and Shetlands and the northern coast of Norway.

More or less parallel with it run the lines of the Hebrides, of the Minch, the Findhorn, the Spey, the Grampians, Loch Awe, Loch Fyne, the Ochils, the Pentlands, indicating three great lines of disturbance, not shown on ordinary maps, but for which you must look to a geological map—one from the Sound of Sleat to Loch Eriboll, the second from the mouth of the Clyde to Stonehaven, the third from Luce Bay to Dunbar.

Now look at the other series—that from NE. to SW. Beginning in the north we have. to mention only the most important, Strath Ullie, Loch Shin, Loch Broom, Loch Maree, the various transverse depressions in the Hebrides, Loch Torridon, Loch Hourn, Loch Morar, the Sound of Mull, part of the Tay, of the Clyde, Loch Ryan, and Luce Bay, and the North Channel. The predominance of these two lines on the geography of our Islands, and indeed of the world, has not yet, I think, received the consideration it deserves.

Professor Bonney called attention to this tendency in his second lecture on the "Growth and Sculpture of the Alps." "On considering," he says, "the general disposition of the rocks constituting the Alpine chain, we perceive that, in addition to the long curving folds which determine the general direction of the component ranges, they give indications of a cross folding."

He suggests three possible explanations: "(1) That the Alps are the consequence of a series of independent movements, not simultaneous; (2) that the chain was defined in its general outline by a series of thrusts proceeding outward from the basin of the North Italian plain, and afterwards folded transversely by a new set of thrusts acting at right angles to an NNE. line; (3) that the transverse disturbances are the older, and that the floor on which the Secondary deposits were laid down had already been disposed in parallel folds."

He adopts the third hypothesis. He considers that the transverse wrinkles were perhaps Triassic, "not improbably post Carboniferous," and therefore far older than the main longitudinal folds. "Still," he continues, "though I incline to this view, the question is so complicated that I do not feel justified in expressing a strong opinion, and rather throw out the idea for consideration than press it for acceptance. All that I will say is that I find it impossible to explain the existing structure of the Alps by a single connected series of earth movements."

The existence of these two systems at right angles to one another is by no means peculiar to Scotland then. It is as marked in Switzerland, and occurs in other mountain regions. Under these circumstances

I have ventured to make the above suggestion. If the elevation of the Swiss mountains be due to cooling and contraction leading to subsidence, it is evident that, though, so far as I am aware, this has not hitherto been pointed out, as the main folds run SW. and NE., the subsidiary ones would be NW. and SE.

If these considerations are correct, it follows that, though the main valleys of Switzerland have been immensely deepened and widened by rivers, their original course was in most cases determined by tectonic causes.

Again, they indicate why the long valleys are not more continuous.

If we look, for instance, at a map of the Jura, we see that though the ridges follow the same general curve from one end to the other, they are not continuous, but form a succession of similar, but detached ridges. Moreover when a valley is continuous for many miles it is interrupted here and there by the cross folds.

These considerations then seem to account for the two main directions of the Swiss valleys.

In many cases the position of the transverse valleys is to be accounted for by that of these transverse synclinals. The position, for instance, of the transverse Rhone Valley between Martigny and the Lake of Geneva, and of the Lutschine between Lauterbrunnen and Interlaken were, I believe, determined by the existence of such transverse synclinals.

The great angle of the Rhone at Martigny is one of the most remarkable features of Switzerland. But though remarkable it is by no means unique. The Rhine near Chur, the Aar near Brugg, the Inn near Kupstein, make similarly sudden bends, and many other cases might be given.

The result is that we get in mountainous countries two classes of valleys, the main ones longitudinal, crossed by others at right angles. The main Swiss longitudinal valley is that of the Rhine and Rhone, which crossed as it is by a main transverse valley, that of the Reuss and Ticino, divides Switzerland into four main divisions.

We generally think of the Rhine valley and the Rhone valley as two separate valleys, but a glance at the map shows that it is in reality one great valley, and is due to tectonic causes, that is to say to the great compression which has elevated the Swiss boss, and has only been deepened and regularised by the rivers, or mainly perhaps by the glaciers.

The relation of geological structure and surface configuration is however often concealed by the immense amount of denudation which has taken place.

The Jura affords a most interesting and conclusive illustration of a gently folded district. Nowhere else can the process be more clearly followed. There are about 160 undulations and about 15 main folds, and the relations between geological structure and geographical features can nowhere be more clearly seen.

And now I come to a most unexpected feature, and one of the utmost magnitude and interest which appears to have been gradually

established by the researches of geologists, especially of Messrs. Bertraud, Lugeon and Schardt, and last but not least of Heim.

Steep as is the slope from the plain of Switzerland to the summits of the Alpine range, the drop to the plain of Lombardy on the Italian side is much more abrupt. The consequence, as in all such cases, is that the steep side wears away more rapidly than that on which the descent is more gentle. Rain and frost and rivers have of course more power on the steeper than on the gentler slope. The result is that the crust of the Alps is continually receding towards the north.

If we carry back our imagination some thousands of years the ridge must have then been some miles south of the present position.

This throws light on the remarkable fact that in some of the most recent Swiss deposits we find pebbles and blocks of stone of a character which does not occur on the Swiss side, and which must have come from the Italian side of the present crust.

Some of these blocks are of gigantic size, even up to 100 feet in length. In the Habkern valley, for instance, near the Lake of Thun, are many great blocks of a peculiar and beautiful red granite, so abundant that it is known as Habkern granite, which nowhere occurs *in situ* on the northern side of the Alps, and must have come from Italy. Again, it has long been known that the mountains round the Lake of Lucerne —the Mythen, the Buochser Horn, and others, though composed of strata of the same age as those which occur in Switzerland are not of the same character—they were deposited under different conditions.

It has also long been known that in many places older rocks are now lying over newer ones: that some of the mountains so to say have no roots, but are as it were swimming on more recent deposits.

Such "overthrusts," as they are called, are of special interest to Scotsmen, because it was in the Highlands that they were first demonstrated on a large scale.

Before coming, however, to such cases let me lead you on gradually. The district known as the Jura falls into two well-marked divisions, the Tabular Jura in which the strata are horizontal, and the Folded Jura in which they are thrown into folds. Now at the line of junction of the Tabular and the Folded Jura the latter is generally more or less thrust over the former.

Again, almost everywhere where the condition of the older rocks is shown *in situ* they are seen to be thrown into great folds, and are in many cases vertical and even overhanging.

It has been calculated that the strata between Basle and Milan, a distance now of about 130 miles, would, if extended horizontally, occupy 200. There has consequently been a shortening of at least 70 miles, and probably more.

Now what would have happened when the deeper-seated strata of any particular region were being thrown into these great folds, and the distance between two given points on the earth's surface was thus being shortened to the extent of several miles? It is evident that the strata nearer the surface would be forcibly pressed one over the other in more or less wild confusion.

In the Glarnisch mountain, for instance, we find the following sequence. The Eocene, which is the most recent rock, forms the base. On it are piled successively Upper Jura, Dyas, Middle Jura, Upper Jura, Lias, Middle Jura, Upper Jura, Neocomian, Valengian, Neocomian, Urgonian, Neocomian, Valengian, Neocomian, and lastly Urgonian.

Here it is evident Neocomian deposits are repeated four times. It is evident that Neocomian strata have been four times thrust over one another, and the valleys surrounding the mountain have, of course, been subsequently excavated.

It is naturally impossible in the course of a single lecture to bring before you in all its force the evidence on which the conclusion rests, but I trust I have said enough to indicate the evidence which by degrees and irresistibly has led geologists to the conclusion that the mountains, and, indeed, practically the whole of Switzerland from the Aron to the Reuss form an overthrust, which has come some miles from the south. That the rocks composing these great mountains—the Garnish, the Santis, the Matterhorn—are not *in situ*, but are, so to say, an exotic, but enormous, block, which comes from what is now the southern slope of the Alps, however astounding and almost incredible it may be, appears from the light of recent researches to admit of no other explanation.

(*To be continued.*)

GEOGRAPHY AT THE BRITISH ASSOCIATION.

In our October issue we published Major Hills' presidential address to Section E; it only remains to give some account of the proceedings of the section. The officers were as follows:—President—Major E. H. Hills, C.M.G., R.E.; Vice-Presidents—George G. Chisholm, M.A., B.Sc.; Rev. W. Spotswood Green, C.B., M.A.; J. G. Bartholomew, F.R.S.E.; Captain H. G. Lyons, R.E., D.Sc., F.R.S. Secretaries—O. J. R. Howarth, M.A. (Recorder); W. J. Barton, B.A.; E. A. Reeves; W. F. Bailey, C.B.

The meetings were held in the Rooms of the Royal Dublin Society, Kildare Street, and began on Thursday, September 3, when Major Hills delivered his address. He was followed by Professor W. M. Davis of Harvard, who read a paper on the "Physiographic Subdivisions of the Appalachian Mountain System, and their Effects upon Settlement and History." Prof. Davis said that the Appalachian mountain system of the eastern United States might be divided into two longitudinal belts—the crystalline Appalachians on the south-east, and the stratified Appalachians on the north-west; with these might be associated the Appalachian plateau, of horizontal structure, next further north-west. Each belt varied somewhat when followed along its length. The crystalline belt was low, narrow, and interrupted in a middle section; it was higher and broader in the north-east and in the south-west. The stratified belt was most characteristically developed in a middle section, where alternations of resistant and weak strata result in alternations of ridges

and valleys; in the north-east the ridge-making strata were absent; in the south-west they were of less strength than in the middle section. The plateau belt continued in full strength along the greater part of the stratified belt in the United States, but it terminated in eastern New York; further north it might be said to be replaced by the Adirondack Mountains, separated from the plateau by the Mohawk Valley. The relation of these various features to geological structures and to processes of erosion, and their effects upon settlement and history, were briefly sketched in the paper.

In the afternoon the Rev. W. Spotswood Green, C.B., delivered a lecture, which was illustrated with some admirable lantern slides, on "Ireland: her Coasts and Rivers." There was a large attendance. The lecturer, in the course of a most interesting address, treated the succession of events in the geographical history of Ireland from the time that the river valleys were being sculptured and the present configuration of the country determined, through the great Arctic and forest periods to the coming of man into the island, the evolution and admixture of races, and dwelt finally upon the beauty spots with which Ireland abounds.

On Friday morning the proceedings opened with a paper by Professor R. A. Gregory on "School Geography as a Mental Discipline." The paper followed lines somewhat similar to those of a paper by the same author which appears in the summer number of *The Geographical Teacher* (iv. 5), but the subject is so important that we give the abstract in full:—

"No teaching of science in schools is satisfactory unless the scientific method of study is followed. There are many science subjects, but only one scientific method; and it consists in the collection and arrangement of facts—obtained so far as possible by personal observation and experience—with the view of discovering relationships and arriving at correct conclusions. A literary subject taught in this spirit is of greater educational value than a science subject in which the instruction is chiefly of a didactic character. What is most important is not the subject, but the method, of study.

"In the modern teaching of physics, chemistry, nature-study, and similar subjects in schools, the aim is not so much to accumulate a large amount of information—useful or otherwise—as to create and foster an active and independent habit of mind; individual contact with facts, and the critical study of evidence, are thus encouraged instead of the passive absorption of statements made by a teacher or a text-book.

"By the introduction of practical exercises both in school and out, geography is being brought into line with other subjects taught by truly educational methods. It is being recognised slowly that the scientific aspects of geography should be matters of personal observation rather than of description. Nothing should be told a pupil which he can find out for himself by suitable exercises. The construction of a plan from actual measurements gives a knowledge of scales; and with this mental equipment the transition is easy to a simple map of the district, upon which exercises can be set. When such a map is under-

stood, work may be done upon maps of the British Isles, either physical, political, or showing roads and other ways of communication. After the natural physical divisions of our islands have been studied by exercises based upon orographical maps, the characteristics of British climate may be investigated. For this purpose familiarity with meteorological instruments is necessary.

"It is an educational axiom that no numbers or other symbols should be used until their meanings are understood. No study should be made, therefore, of records of temperature, rainfall, or other meteorological phenomena unless the numbers convey definite ideas to the pupils. In all cases pupils should be encouraged to arrive at a principle or generalisation from the material put before them, whether in the form of results of observation or of maps. It will then be understood that every point upon a map represents results of investigation, and that every geographical generalisation has been obtained by the study of facts recorded by various explorers and observers. This method of approach may be extended to the whole world at any convenient stage of the course, the intention throughout being to use geographical material to stimulate intelligent inquiry, and be a means of mental discipline, rather than as information to be remembered merely. The practical exercises in the classroom as well as in the field should thus be regarded as illustrations of the methods by which geographical science has been built up, and as providing a vocabulary by means of which geographical facts may be interpreted.

"It must not be supposed that the neglect of the human and imaginative side of geography is suggested; all that is here advocated is that whenever possible pupils should be brought face to face with evidence and trained to study it. The best way to obtain evidence is by direct observation; but as it is not practicable for a single investigator to compass the world by personal inquiry, the results of observations made by others may be used as material to be sorted, grouped, compared, and generalised, provided that its nature is understood. Combined with this collection and consideration of concrete facts there should be a course of reading or descriptive lessons intended to inspire interest in the earth and its inhabitants, and to cultivate appreciation of what may be termed the intangible influences and factors of geographical character. Taught in this way, geography may be made one of the most valuable subjects in a school curriculum, for it provides not only the intellectual discipline of a science rightly studied, but also the human interest and sympathy of the most inspiring literature."

Professor Gregory was followed by Professor John L. Myres, who read a paper on the "Geographical Study of Mediterranean Man, considered as an Element in Classical Education." This paper we hope to publish here at a later date.

Dr. W. S. Bruce then gave an account of the scientific results of the voyage of the *Scotia*. After very briefly recalling the narrative of which, he pointed out, he had previously given an account, he passed on directly to summarise some of the more important results. We give this summary in Dr. Bruce's own words:—

"The *Scotia* was specially fitted out for oceanographical and meteorological research in high southern latitudes.

"*Magnetism.*—No magnetic research was done on board the *Scotia* since this was not compatible with deep sea-trawling, sounding, etc., but at Scotia Bay, South Orkneys, a magnetic observatory, named Copeland Observatory after the late Professor Ralph Copeland, was set up where Mr. R. C. Mossman carried out a long and important series of magnetic observations during the wintering of the *Scotia*, and during her absence coaling and refitting at Buenos Aires for the second voyage.

"*Tides.*—Tidal observations were made under the direction of Captain Thomas Robertson every half hour at Scotia Bay. These are of special interest as being a record in the most open stretch of ocean in the world. Their normality is their striking characteristic.

"*Meteorology.*—Meteorology was specially emphasised both during the voyage and the wintering at Scotia Bay. The observations were taken by and under the direct supervision of that distinguished meteorologist, Mr. R. C. Mossman, and have afterwards been discussed by him, and thus the meteorological results of the *Scotia* are probably more important than those of any other Antarctic expedition, and more especially so since the Argentine Republic agreed with Dr. Bruce to continue the Scotia Bay observatories, and have now secured five years' continuous records there. One of the most important results of these meteorological records is that they seem to indicate an extensive continental land-mass not far to the south and west of the South Orkneys. This is specially emphasised by the observations at Scotia Bay, off Coats Land, and near the position where Morrell reported land and Ross an 'appearance of land' The observations show that the line between the easterly and westerly systems of weather is in about 65° S. in the Weddell and Biscoe Seas; the South Orkneys are well within the westerly system.

"*Ocean Physics.*—Little can as yet be said regarding the physics of the sea as the very large and important series of observations taken by the *Scotia* are only now being worked up, but they must give us a large amount of new and important information.

"*Deep Sea Deposits.*—The deep sea deposits indicate, by the continuous band of terrigenous deposits between 65° and 74° S., a corresponding continental coastline to the south. The characteristic blue muds, as well as great rock-masses—strongly continental in character—give ample proof of an extensive continental land-mass to the south.

"*Bathymetry.*—The results of the extensive sounding operations of the *Scotia* are most important as they entirely change our ideas of the bathymetry of the South Atlantic Ocean, the Weddell and the Biscoe Seas. The Ross Deep has been obliterated, and relatively shallow instead of very deep water was found to extend to the northward. Actually in the position where Ross reported 4000 fathoms no bottom, Bruce reached bottom in 2660 fathoms and brought up a sample of blue mud. Connecting Rises of less than 2000 fathoms join Graham's Land, South Orkneys, and the Sandwich Group as well as the south of South

America, Falkland Islands, South Georgia, and the Sandwich Group—thus uniting South America and Antarctica. South of Gough Island, where the *Scotia* naturalists made interesting ornithological collections, Dr. Bruce sounded out a continuance of the Mid-Atlantic Rise a thousand miles to the south, and this Rise probably joins another Rise between the Sandwich Group and Bouvet Island, which Rise continues north-eastward to meet Madagascar and the East Coast of Africa. The Deep lying to the east of Argentina therefore seems to be separate from that of the Biscoe Sea, and both these are separate from the Deep lying to the south-west of South Africa.

"The shelving of the water in the south and west of the area bathymetrically surveyed by the *Scotia* in the Weddell Sea also gives additional weight to the hypothesis of an extensive and continuous land-mass existing between Kemp, Enderby, Coats, Morrell and Ross's supposed land, and Graham's Land.

"*Topography.*—The Scottish Expedition, concentrating as it did on Oceanographical Research, did not do extensive land work, but while wintering in Scotia Bay they surveyed Laurie Island, South Orkneys, in great detail on a scale of two inches to the mile. They included in this survey local hydrographical work, taking about 500 soundings in Scotia Bay, Jessie Bay, Brown's Bay, and elsewhere. This was especially heavy work, for each sounding was preceded by cutting through ice from 3 to 5 feet in thickness. A running coast survey was also made of the north side of Coronation Island, as well as of 150 miles of the extensive new coastline which the expedition discovered, and which Dr. Bruce named Coats Land in honour of the two chief supporters of the Scottish National Antarctic Expedition. The discovery of Coats Land forms one of the most striking features of modern antarctic explorations, and clinches the fact of a northward extension of Antarctica into the Weddell Sea. The definite existence of Coats Land, and all the evidence obtained from Bellinghausen, Weddell, Morrell, Biscoe, Ross, and Moore support Dr. Bruce's continental hypothesis and his further hypothesis of former extensive land masses having previously united Antarctica with the more northern continents. The probability of the permanence of ocean basins is also greatly reduced.

"*Biology.*—The biological collections of the *Scotia* are by far the most important yet obtained by any antarctic expedition. Besides surface and shallow-water collections, the Scottish naturalists trawled in great depths not only south of 40° S., but also south of the Antarctic circle, many trawlings being in water exceeding 2500 fathoms. All this work was done in a sea heavily encumbered with ice, which made operations often hazardous and even dangerous. Bipolarity fades away, for not only do north and south polar species differ widely, but even species from different South Polar areas. The northern extension of Antarctica at Graham's Land appears to be a potent factor in this matter."

Mr. W. L. Grant subsequently described the northward expansion of Canada with reference to the visit of the Association to Winnipeg in 1909. He said that at its formation in 1867, Canada extended from the Atlantic to Lake Superior; by the purchase of its rights from the

Hudson Bay Company in 1869, and by union with British Columbia in 1871, it extended to the Pacific.

"But a country is really measured not in square miles, but in the area which men can inhabit and develop. At Federation the inhabited country was but a thin and broken strip along the American frontier. Wildernesses separated the Maritime Provinces from Quebec, and Ontario from the West; from Winnipeg to the Rocky Mountains was the home of a few Indians; three ranges of mountains shut in British Columbia. North of the 'Height of Land' in Ontario and Quebec all was wilderness. Canada was length without breadth, and even the length was not continuous.

"The progress of the country has consisted not so much in any change of climate or of geographic conditions as in (1) the spread of knowledge as to what the conditions really are; (2) with the growth of knowledge the growth of popular confidence; (3) the conquering of such conditions as were unfavourable. Man is to-day the ruler, not the slave, of geographic conditions. He is no longer forced to follow the rivers; settlement no longer creeps from point to point. The railway goes hundreds of miles in advance of settlement, and everywhere finds land where men may live and prosper. The new transcontinental railways pass through the province of Alberta more than 300 miles north of the American frontier, and already settlement has extended north of the railways. In Ontario and Quebec, north of the Height of Land, great tracts are being opened up by new railways, and are being found rich not only in minerals and in timber, but also in arable land. A study of railways is to-day more important than a study of rivers.

"With this widening of habitable territory goes an increase in political and economic unity; that which was at first only a paper federation is being welded together.

"At the heart of this network of railways lies Winnipeg, the central city of Canada. The railway map of Canada is in shape not unlike a wasp, with its waist at Winnipeg. Perhaps the greatest danger to which Canada is exposed is that the waist may be too small. A railway running north of Lake Winnipeg should be one of the next links forged in the building together of Canada."

Saturday was as usual devoted to excursions.

On Monday morning the proceedings opened with a paper by Mr. G. A. Reeves, F.R.A.S., who described three instruments recently designed for the use of travellers and surveyors. We quote the description in full:—

1. *The Distance-finder Alidade for Plane Tabling.*—This consists of an aluminium ruler 2½ feet long, at each end of which is fitted a small telescope placed at right angles to the ruler. One telescope has a vertical and horizontal wire only fitted in the diaphragm, while the other, in addition to these, has a movable micrometer wire and drum. In taking a distance the plane-table with the alidade is levelled, and then the telescope with the simple cross wire only is sighted on to a definite point of an object of which the distance is required, after which the surveyor passes to the other telescope, and, covering the same point of the object with the movable micrometer wire, reads off the divisions recorded

on the micrometer. To eliminate errors in parallelism, the measurement is repeated with the alidade and telescopes reversed, and the mean of the divisions noted. With this mean a scale on the alidade ruler is entered and the corresponding distance in feet read off. A 2½-foot instrument will give direct distance up to about 1000 feet with fair accuracy; by repeating the observations and with the distance so obtained, by a simple system of similar triangles, distances eight or ten times as far can be measured without altering the position of the plane-table. The whole operation is very rapid, and the great advantage of the instrument is that it enables a surveyor to fill in a considerable amount of detail without moving his board, and that he can obtain distances to points which he may be unable to reach. The telescopes can be taken off the ruler, and one of them is fitted with a small circular arc and can be placed in a line with the ruler, when the instrument can be used as an ordinary telescopic plane-table alidade. Larger sizes of the distance-finder, with longer rods, are made fitted to a stand as a separate instrument, and the instrument can be combined with a theodolite for traversing.

2. *The Astronomical Compass and Time Indicator.*—This is a simple and inexpensive little instrument for quickly finding the north and south line and the true bearing of any object, as well as the local mean time by the sun or stars with sufficient accuracy for all ordinary purposes. It has been designed to meet the requirements of travellers and for night-marching, when the ordinary magnetic compass cannot be relied on.

All who have had anything to do with route marching with a magnetic compass know the difficulty there is with local attraction. The needle is always liable to be drawn round out of position by ironstone or any article with iron in it which might be inadvertently placed near the compass, and the traveller may be quite unaware of the fact until it is too late. Then there is always the normal declination of the needle to consider which varies with the latitude, and amounts to many degrees in places, and which leads to many serious mistakes; so that, if any simple means could be devised for giving the traveller the true bearing of his line of march, or of a distant object, without computation, it must be a great boon to him. To meet this demand Mr. Reeves has invented his Astronomical Compass and Time Indicator. The instrument is extremely simple in design, and, by its use, any one can find the true bearing of his line of march by the sun or stars in a few seconds. Even if he has practically no knowledge of astronomical objects he can learn to use this instrument quite well after about five minutes' tuition. For working with the sun no knowledge whatever of astronomy is required, and for the stars all that is wanted is a knowledge of the name of the star being observed. As only large stars are used, this presents no difficulty. The astronomical compass not only gives the true bearing, but, by a simple arrangement, furnished the time, without computation, by the sun and stars. It is inexpensive, costing only a few shillings, and most portable.

The instrument consists of two small discs, upon each of which is a projection of a hemisphere drawn on the plane of the meridian. One of the discs shows, in black, parallels of declination of the principal stars and of the sun at different dates, with hour circles subdivided into five minutes, while the other, the upper one, is transparent and shows, in red, curves of altitude and azimuth. The two discs are centred on a pivot, and the transparent one is weighted at the lower part to keep it vertical. Through the central pivot passes a pin, carrying a sight-rule or alidade on the front of the transparent disc and fixed to the handle at the back.

When the instrument is used as a *compass* the N. or S. pole of the declination circle is first set to the red number on the transparent disc equal to the latitude of the place; then, allowing the discs to swing freely, clamped together, a rough altitude of the sun is taken through the sight-rule. The altitude circle indicated by the pointer at one end of the sight-rule is now followed across the disc until it intersects the curve of declination of the sun or star observed, seen through the transparent disc, and the red longitudinal curve passing through the point of intersection gives the true bearing or azimuth of the star or sun at the time. Then, considering the upper disc as a compass card with the zenith as the true N. point, the sight-rule is set to this bearing, counting the degrees round the circumference of the disc. Now when the discs are held horizontal with the sight-rule aligned on the sun or star observed, the true north will be indicated by the large red arrow on the transparent disc. There is an additional movable pointer which can be previously set to any bearing upon which it is desired to march. The lines are all bold, so that they can be read off easily at night. The whole operation is extremely rapid, so that bearings at intervals of a quarter of an hour or so can be taken without delay.

The same observation that gives the true bearing also furnishes *the time*, since the hours and minutes read off the black figures of the declination disc at the point of intersection indicate the hour angle of the sun or star. This hour angle, of course, in the case of the sun gives the local apparent time, which can be converted into mean time by applying the equation of time taken from the table at the back, where a diagram is also given from which the approximate local mean time can be quickly found, without any computation, from the hour angle taken off as in the case of the sun.

3. The third instrument is a new form of reflecting *artificial horizon*. It is intended for land or sea use, and it is hoped will be of service in Polar exploration on moving ice. The special advantages claimed for it over other attempts at the same kind of instrument are (1) that by the system of taking observations errors are counterbalanced and a good mean obtained; (2) that it can be readily fitted on in front of a sextant when required for use, and afterwards taken off; (3) that no arrangement is required for illuminating wires for star work. Meridian altitude latitudes on land have been frequently taken with this artificial horizon to within 8″ or 10″ of the truth, and on sea the results should be near enough to be quite useful.

This artificial horizon is very simple in construction, consisting merely of a reflecting mirror kept horizontal by a short weighted pendulum, of which the weight is slightly below the centre of gravity. The mirror is adjusted to move accurately in the plane of the index and horizon glasses of the sextant by means of adjusting screws, and altitudes are taken in pairs, the artificial horizon being reversed laterally between each observation and the mean result accepted. This is a special feature in connection with the instrument, and to a great extent eliminates errors.

Mr. H. G. Fordham read some "Notes on the Cartography of the Counties of England and Wales," in which he summarised the results of his inquiries into the history, bibliography, and geographical characteristics of the maps of the English and Welsh counties. From the survey of Christopher Saxton, and the publication of his atlas of thirty-four maps in 1579 to the present day, there had been, he said, a remarkably complete sequence of such maps, which would repay a

careful study, both from the point of view of the science of cartography and that of the artistic side of topographical representation. The author, in examining exhaustively the cartography of two English counties (Hertfordshire and Cambridgeshire), had established the chronology and characteristics of the maps of the whole period reviewed, and had followed up in detail the history of the publishers, engravers, and topographical writers of the three centuries in their connection with British cartography generally. He indicated the position of the Dutch, Flemish, and French schools of geographers in relation to the contemporaneous work in England at different periods, and established a classification by reference to the initial meridian lines adopted, and to the style and art developed by engravers in this department. He also noticed the principal authors and their best-known works in chronological order, and mentioned, by way of illustration, that in all about four hundred maps had been published of the county of Hertford, of which, however, more than one-half were reprints, more or less altered from the original plates. Any complete collection of the whole series of engraved maps of a county in England or Wales, 1579-1900, would contain approximately the same number. The object of the communication was to draw attention to the large and almost unworked field of research which existed in connection with the bibliography and classification of maps from the early period of their production by the engraver's art.

In the afternoon Captain Lyons, R.E., F.R.S., gave an illustrated address on "The Longitudinal Section of the River Nile." He said that the increase of cultivation in Egypt during the summer months had necessitated an increased supply of water during the low stage of the river, and at this season of the year the equatorial lakes, and that portion of the Nile system which flowed from them, alone could furnish it. The Abyssinian tributaries—the Sobat, the Blue Nile, and the Atbara—were in these months discharging little or nothing. As soon, therefore, as the Dervish power had been broken, the survey of the Upper Nile was commenced. During the past eight years much had been done, and among other results an almost complete line of levelling now existed from the Mediterranean to Lake Victoria, a distance of 3500 miles. This newly-acquired information enabled us to discuss the longitudinal section of the Nile more completely than had hitherto been possible. A discussion of the material now available showed that the probable discrepancy where the two portions of the line join was not greater than about 25 feet or 30 feet.

The section showed clearly the great crustal blocks of which the equatorial plateau was composed, while the lakes occupied the level surfaces of the blocks—as Lake Victoria, Lake Choga, Lake Albert Edward, and Lake Albert. This portion of the basin exhibited the characteristic features of recent development. At the foot of the equatorial plateau the level plain of the Sudan commenced. Through these the rivers of the region drained—viz., the Bahr-el-Jebel, the Bahr-el-Zaraf, and others—but now their slope was known not to be very low, being about 1 in 20,000, or a little more than three inches to

one mile. The great development of marshes in this region was not so much due to the flatness of the plains as to the water-level being so near to that of the flood plains that vegetation grew luxuriantly throughout the year, and all the river silt was arrested in the upper reach, so that the flood plains were not being built up.

Between the Sobat river and Khartum was the flattest portion of the whole course of the river; the slope varied from one-half to one-third of an inch per mile, and when the Blue Nile was in flood the White Nile was ponded up and presented an absolutely horizontal surface for 300 miles.

Below Khartum the character of the river bed changed; reaches of rapids where the river was eroding the crystalline rocks alternated with reaches of lower slope where the rock was sandstone. These crystalline rocks, therefore, formed natural obstructions, which could easily be converted into dams for storing up water in the valley above. When the question of increasing the volume of water stored in the reservoir at Aswan was under consideration, three of these reaches were contoured carefully to determine what volume of water could be stored in them.

In these rapids the slope was at times steep, but never for any considerable distance, and the mean inclination rarely exceeded 1 in 1000 for any length of river. At no point could the river be said to descend a vertical fall, as the term cataract might be thought to imply; but the cataracts of the Nile were in fact reaches of the river in which it had cut its way down to portions of the ancient and uneven land surface formed of the crystalline rocks on which the sandstones of Cretaceous age had been laid down. The position of the ridges of this ancient land had determined the places where cataracts occurred, but the water-channels in them followed the lines of weakness due to bands of softer rock or to lines of fracture caused by the movement of the crust during long ages. The last of these barriers was at Aswan, and below this the river flowed in the wide alluvial plains which it had formed by deposition, and which it was building up at the average rate of about four inches per century. The equatorial plateau and the region of the cataracts were regions in which the river was eroding at the present time, while in the Sudan plains and in Egypt deposition was taking place. But little accurate levelling had as yet taken place along the Abyssinian tributaries, and from Khartum to Fazogli along the Blue Nile only were the levels reliable. Here in one reach near Singa the slope was markedly less than either upstream or downstream of it, and this might be due to a warping of the crust at this part; but more evidence was needed.

On Tuesday Mr. L. C. Bernacchi described a journey into the primeval forests of tropical Peru. His paper dealt mainly with the region of the Rio Inambari, which the author visited, and where a preliminary survey was carried out in 1907, at the expense of an English rubber company, in a district practically unexplored. He started from Santa Rosa, on the Peruvian Corporation Railway. On the steep eastern slope of the Andes a notable variety in succession of temperature, scenery, and vegetation was observed, as were remains of a

former population. The present population was mainly Quichua, with whom the Atsahuaca, of whom there were few, strongly contrasted in their excellent nature and disposition. The Atsahuaca were nomad hunters and monogamists, and were nearly extinct in the Inambari valley. The author quoted at some length from the survey report; the work carried out was the most complete survey yet made of this part of the Continent. Rubber and trading companies were gradually opening up the country. The forests of the Inambari abounded in fine Para rubber trees of the Hevea variety. The writer said that on the slopes of the Andes he had discovered a sweet potato, which grew on thin, poor soil at a height of 4000 feet or 5000 feet, and which he had himself successfully cultivated—producing on a small plot between half a bushel and a bushel. It might well be of service in Ireland.

The Rev. George Furlong described his "Unique Experiences at the Birth of a Volcano." He witnessed, in August 1905, the birth and development of the volcano now called O Le Mauga Mu, in Savaii, which island exhibited lava fields in almost every stage of formation. After a period of earth unrest, two fissures opened on August 4, flame-coloured steam and vapour broke forth with heavy explosions, masses of débris were ejected, and soon began to build up the crater. Streams of lava carrying other matter rolled from the vent; their rate of progress was calculated at half a mile in twenty-four hours. The behaviour of these lava streams was watched and described in detail by the author, who pointed out (among other phenomena) that the surface of the lava quickly solidified, and thus a tunnel was formed through which the flow went on, so that between the crater and the vast columns of steam where the lava reached the sea, it was difficult to realise that volcanic action was in progress. It was noted that the volcano was more active during the period of full moon than of waning moon; also that the fumes from the volcano were not always of the same nature. Several tidal waves were experienced, always in the same place, and were about 500 yards wide, and flowed inland about 100 to 120 yards. These waves were observed to occur when the crater was more than usually active.

Dr. W. S. Bruce followed with a paper on his exploration of Prince Charles Foreland. This subject we hope to treat of fully here at a later date.

The next paper was on the marble arch caves in county Fermanagh, by Mr. Harold Brodrick, who said that three streams flowed down the northern slope of Cuilcagh and sank into the limestone at three points about a quarter of a mile apart; the central stream went by the name of the Monastir. The narrow limestone valley through which it ran was cut off, at its lower end, by a limestone cliff 130 feet high. The cave at the base of this had a total length of 40 yards, and ended in a fissure of unknown height. Within 40 yards of the top of the cliff was a pot-hole (Pollbwee) 100 feet deep, with a pool and a narrow passage 60 feet in length at the bottom. Further north was an opening in the moor called Pollnagapple; this was a pothole with a diameter of 80 feet and a depth of 60 feet. Its floor was composed of jammed boulders,

below which the river could be heard; a high cave with good stalactitic deposits led from the bottom of this pot. About 150 yards further north was Cradle Hole—a pothole 80 yards in diameter and 120 feet deep; at the base were two caves in which the stream was met with; upstream the passage, 15 feet wide and 25 feet high, had been explored for 55 yards, but had not been surveyed. The downstream cave was from 10 feet to 25 feet high and 30 feet wide; it was 104 yards long and ended in a pool within about 20 feet of the upper end of Marble Arch Cave. The roof seemed too low to admit of passage. The Marble Arch Cave was entered from lower down the hillside. At the upper end of the stream course was a pool, probably the continuation of the one met with in Cradle Hole. The stream flowed for 123 yards along the "Grand Gallery," through boulders and shingle, to the "Junction." The "Grand Gallery" was from 5 feet to 20 feet high and about 15 feet wide. From the Junction a dry passage ran to the right, and at a distance of 45 yards became 20 yards wide and about 40 feet high; the floor rose to the left, but the passage continued forward to the right. To the left the rising floor was composed of boulders and sand cemented together and covered with stalagmite. At the upper end of the slope was a fine collection of stalactites. A low passage 15 feet wide led from here into a fissure cave 30 feet high and 50 feet long. The low-level passage at the bottom of the boulder slope continued for 93 yards, 15 feet to 25 feet in height and about 10 feet in width, to the "Pool Chamber." This was about 15 yards in diameter and 20 feet high, and had a still pool at its lowest point. The portion of the cave beyond the Pool Chamber and the two openings there were unknown before this year. Fluorescin put into the Monastir Sink at 11.30 A.M. in dry weather was clearly visible at Cradle Hole at 10.45 A.M. the following day, and at 6.45 the same evening began to emerge at the Marble Arch spring.

Dr. C. A. Hill described Mitchelstown Cave, the largest yet discovered in the British Isles, which was, he said, situated in county Tipperary, in the valley of the Blackwater. There were actually two separate and distinct caves. The existence of one, the "old" cave, was now forgotten, though this cave was known and exhibited in 1777. The "new" cave, first discovered in 1833, was now the only one shown to visitors. It was first described by Dr. Apjohn, of Dublin, who partially explored and surveyed it in 1834, and published a map which had been the basis of all others up to the present time. It was further explored by M. Martel, of Paris, in 1895, and described by him, and was also visited by Dr. Lyster Jameson, of Dublin, who described the cave fauna found therein. Very little was known of the full extent of the caves even at the present day, and no trustworthy plan or map existed. The cave was visited in 1905 by the author, who took many photographs now shown for the first time, and also explored portions hitherto unvisited. The cave was found to be of much greater extent and complexity than was previously imagined.

There is great need for systematic exploration and surveying, as the existing plan of the "new" cave has been found inaccurate and mis-

leading, and practically nothing is known of the "old" cave. Geologically the "new" cave is of great antiquity, as evinced by the enormous size and number of the stalactite and stalagmite formations. There is no evidence of present active water-action, the cave being practically dry, except at two points erroneously called "the River." The explored passages are estimated at a mile and a quarter in length.

This closed the proceedings of the section, but papers were read in some other sections which had a more or less geographical bearing. Thus in section A, Dr. W. N. Shaw read a paper on the meteorology of the winter-quarters of the *Discovery*. By means of photographs of models he showed the position of the ship with reference to the configuration of the surface and the position of the great ice-barrier. The feature of the observations consisted in the fact that the explorers enjoyed the unique opportunity of obtaining a continuous record of the climate, as distinguished from occasional weather observations which earlier expeditions had been able to collect. From February 1902 to March 1904, meteorological observations were made every two hours, and he congratulated the observers on rising superior to the disadvantages of the inhospitable climate. The position of the ship, approximately south of New Zealand, was nearly 180 degrees distant from the *Scotia's* position, which was south of Cape Horn, and comparison between the observations was most interesting. The temperature fluctuated very considerably and unexpectedly. These fluctuations, which were rapid, extended throughout the year, and occasionally amounted to 45 or 50 degrees within comparatively short periods. The barometric oscillations were unimportant and apparently unrelated to temperature. The record of sunshine, which was obtained on an instrument of unusual construction permitting the continuous registration of sunshine for twenty-four hours, was of a most remarkable character. In December 1903, 496 hours of bright sunshine were recorded, or an average of more than sixteen hours per day. The direction of the wind presented some unusual features. On the surface the prevalent direction was easterly, while westerly winds were practically unknown. The lower clouds showed a more regular distribution in direction, while at an altitude of 13,000 feet the smoke from Mount Erebus gave the prevalent direction west and south-west. At still greater heights the upper clouds showed definite western currents. The actual range in temperature was large, amounting to over 100 degrees; but the daily range was small. The lowest average temperature for a month was 41 degrees and the highest 26 degrees of the Fahrenheit scale. Fogs were infrequent, and the precipitation which took the form of snow was slight. Dr. Shaw discussed the general circulation of the atmosphere in these regions, separating the local effects from the indications obtained at more distant stations which did not exhibit the peculiarities observed in Discovery Bay. The relations between pressure gradient and wind velocity might explain some of the difficulties that had been encountered in regard to the alteration in the direction of wind with altitude. He concluded by expressing a hope that the degree of slope of the great ice-barrier might be determined. If the slope were only one or two feet per mile, its

accurate determination under severe Antarctic conditions presented considerable difficulty.

Dr. Bruce, of the Scottish National Antarctic Expedition, who followed, said he congratulated himself on being able to co-operate with his fellow-workers on the opposite side of the Antarctic regions. The conditions in the *Scotia* were almost precisely the reverse of those experienced in the *Discovery*, though there were some points of resemblance. The rapid variation of temperature, amounting to 30 or 40 degrees in a few hours, was a frequent occurrence, and was sometimes attended with disastrous consequences to the explorers. With a north-west wind the temperature rose, with a south-west wind it fell. Points of difference were that 60 per cent. of the surface winds were westerly; at the station of the *Scotia* they had had very considerable precipitation; an absence of sunshine, and the amount of cloudy weather was so great that the work of surveying was often rendered very difficult. There was, too, no exhibition of aurora, and he understood from the Argentine observers who were carrying on observations in southern latitudes that the scarcity of auroral displays continued. Geographically, he considered that the Scottish meteorological observations pointed to the fact that the coastline of Antarctica stretched far to the north in the position that Morrell and Ross indicated land, and was continuous between Graham Land, Morrell Land, Coats Land, Enderby Land, etc. His view of the existence of a huge land mass was supported by the observations of temperature, wind, and humidity, and he maintained that the continuation of these observations disclosed the existence of an anti-cyclonic area to the south of the Scottish station. He regretted that attempts to make upper atmosphere observations by means of kites had proved fruitless; but the rigging of the ship had been a great obstacle, in attempting to raise the kite on board, while on shore at Scotia Bay the squally nature of the winds carried away the gear and destroyed the kites.

Another very interesting paper read in the same section was that by M. Teisserenc de Bort, who, in a paper on the difference of temperature in the higher atmosphere of the equatorial and polar regions, said that he had shown in a discussion of observations made over the Atlantic with those made near the Arctic circle by the Franco-Swedish Expedition, that a great difference of temperature existed at different altitudes at these stations. In the lower layers the temperature of the equatorial zone exceeded that of the arctic by 25° C. This difference vanished as the altitude increased, until equal temperatures existed at a height of 10 km. With further increase in height there was no further decrease in temperature, because the isothermal region was reached. But near the equator the rapid decrease of temperature with increasing altitude still continued. These conclusions had been confirmed by further observation. They showed that at a very cold period, with temperatures below −15° C. near the surface, the temperature in the upper regions was nearly the same as that found over the equatorial zone, and if the temperature fell below that of equatorial regions the phenomenon was not of a permanent character. In equatorial regions, if one considered

as the point of departure the region where the trade winds meet, near the thermal equator, there was, strictly speaking, neither winter nor summer. No ascent to great heights had yet been attempted in arctic regions during the warm season, and it was hoped to fill up that gap. But from what was already known of the decrease of temperature at different places, and of the observations made at St. Petersburg, temperatures above −50° C. could be counted upon. During a great part of the year it was sensibly colder by 10° or 20° C. in the equatorial regions at altitudes of 15 or 16 km. than in arctic regions. This fact M. de Bort had anticipated some years ago, and it deserved very serious consideration in theories relating to general circulation. The direct cause of the isothermal zone was pointed out some years ago. It was proved that at a great height the general currents flowed, not through the isobars, but along those surfaces, like a body running on an inclined plane. Also the isothermal zone could be compared to the limit of great cyclones and anticyclones, and that conception was in accordance with the observed fact that the velocity of the wind fell very quickly when the pilot balloons came in contact with the isothermal layer. The relation between the height of the isothermal layer and the depth of currents with vertical motion permitted the atmosphere to be divided into two parts—a *troposphere*, in which the circulation presented sensibly vertical components and systematic decrease of temperature with the height, and a *stratosphere*, in which the circulation could be inclined, but flowed along the isobars. The causes which limit the mean depth of the troposphere were not known, but recently Mr. Gold had made some suggestions which seemed most promising. M. Bort concluded by pointing out the causes of the distribution of temperature in upper air of the polar and equatorial regions. First, the air ascending to great heights was more cooled by expansion at the equator than at the poles, where the troposphere was not so deep; and, secondly, in the general motion of the upper air, two masses of air running eastward at the same velocity, but possessing different temperatures, were affected in different manners by the deflecting force of the earth's rotation, and consequently, when all other conditions were equal, the cooler air in the upper regions tended to reach the equatorial regions, and the warmer the higher latitudes.

In Section C (Geology) Dr. Tempest Anderson, with the aid of a fine series of lantern slides, described the changes that had taken place in the Soufrière of St. Vincent since the eruption of 1902. He said that in that year he had visited St. Vincent with Dr. Flett after the then recent eruption. In 1907 he revisited the island and examined the changes that had taken place in the new deposits. In 1902 an incandescent avalanche descended into the valleys which occupied the great transverse depression across the island to the south of the Soufrière, and in particular the Wallibu Valley was filled for a great part of its course to a depth of at least 100 feet, but less near its mouth. In this deposit of red-hot material the secondary phenomena of re-excavation of the valley by the river, the falls of hot ash, the steam explosions, and the flows of boiling mud took place. In 1907 almost the whole of this ash had been washed away, but a fragment remained in the shape of a terrace 60 feet to 70 feet

high situated on the north side of the valley. The ash of which it was formed was unstratified and contained very few ejected blocks or fragments of any kind. The floor of the valley was all composed of water-sorted material, chiefly gravel and coarse sand, but with a good many blocks as big as a man's head, representing ejected blocks and fragments of lava derived partly from the ash of 1902 and partly from older beds, the fine ash in each case having been washed away. The surface of the gravel bed showed marks of quite recent running away, and during the last winter (1906-7) the river ran along the foot of the north bank of the valley. When examined in March 1907, it ran along the south side of the valley and had already in those few months excavated a new channel about 30 feet in depth. The stratification as exposed in this new valley was very distinct, and the sorting by water was evident. Further up the mountain the remains of the avalanche became more abundant in the valley bottoms, and here they were also better preserved, so that traces of the feather-pattern erosion so noticeable in 1902 were still visible on the surface. This was mainly due to the surface of these ash deposits, like those which were found on the plateau and on the ridges, having consolidated into a crust almost like a cement pavement, which resisted the action of the rain. Another interesting point was observed with regard to these massive beds of recent material. Instead of one stream re-establishing itself along the centre of the deposit the tendency was for a new stream to form on each side at or near the junction of the new ash with the old valley slopes, and as these streams deepened their beds two new valleys were formed where only one previously existed, and the walls of each were composed on the one side of the new ash and on the other of older tuff with occasional terraces. Dr. Tempest Anderson concluded his interesting lecture with an account of a visit to Mont Pelée, in Martinique.

The evening lecture on Monday, September 7, was delivered by Professor W. M. Davis, who took for his subject the Canyon of Colorado. Professor Davis is to address this society on the same subject next spring.

In connection with Major Hills' address it is of interest to note that Sections A and E jointly, presented the following resolution:—

"That the Council should approach the Board of Agriculture with a view to ascertaining whether it is not possible for the Director-General of the Ordnance Survey of Great Britain and Ireland to undertake the measurement of the two principal arcs (meridional and longitudinal) as part of the current work of his Department."

The only grants which interested Section E were the two following:—

Murray, Sir John—Rainfall and Lake and River Discharge,	£10	0	0
Murray, Sir John—Investigations in the Indian Ocean, .	35	0	0
Total, . . .	£45	0	0

As to future arrangements Professor J. J. Thomson, F.R.S., was elected President for the Winnipeg meeting, which is to be held from

August 25 to September 1, 1909. The 1910 meeting is to be held at Sheffield, and that of 1911 at Portsmouth.

In connection with the Winnipeg meeting, the following notice in reference to a proposed (non-official) extended Tour of the Canadian Pacific Coast to Alaska, to take place at the close of the meeting, was posted up at Dublin. The full time required is about one month beyond Victoria, and the estimated cost is one pound per day.

The official tour extends through the Rocky Mountains to Victoria, B.C., beyond which it is proposed that the non-official tour should begin by steamship through the Pacific Coast channels to Skagway, calling at Albert Bay, Fort Rupert, Fort Simpson and Juneau, whence "Treadwell," the largest gold mine, will be visited, and a trip taken round by the Muir Glacier, Glacier Bay, Mount Fairweather (rising 15,287 feet direct from the sea), and possibly on to Malaspina, the great retreating continental glacier, thence returning *via* Sitka and Queen Charlotte Islands to Vancouver, this tour occupying twenty days.

From Skagway the ten-days tourists will return by Wrangell narrows direct to Vancouver, but members who can spare a month or longer will be taken from Skagway up the White Pass Railway, through majestic scenery to "White Horse." Here boats will be taken down the rapids of the river Yukon to Dawson City and through Alaska to the mouth of the Yukon at Nome, where the party will board the returning steamer, which will call at the walrus and fur-seal rookeries on Pribiloff Islands and the Aleutian Islands, returning thence *via* Sitka and Queen Charlotte Islands to Vancouver.

For those members who desire to return by the Siberian railway through Russia arrangements will be made to enable them to land at Vladivostock.

Members or their friends who think of taking the ten, twenty, or thirty-day extended tours are requested to notify their intention at an early date to Mr. M. B. Cotsworth, York, England, who is making the preliminary arrangements, which include special terms reduced by grants. Later Mr. Cotsworth will furnish fuller particulars, which will also be available through the Reverend Mr. Bryce of Winnipeg and Mr. Silva White at the offices of the British Association in London.

APPARATUS FOR INSTRUCTION IN GEOGRAPHY AND STRUCTURAL GEOLOGY.

By Professor William H. Hobbs, University of Michigan.

(*With Illustrations.*)

1. *Map Contours.*

Until the student has become familiar with the idea and use of surface contours as employed on hypsometric maps, a very large part of the field of physiography remains closed to him. He is in the position of the student of music who is unfamiliar with musical notation. Thus in a

strict sense he is debarred from making use of the great reference libraries of physiography—the topographic atlas sheets—until he has acquired the language in which they are printed. Some students, and those especially who possess what the Germans term *Vorstellungsgabe* and we *visualising power*, move rapidly toward an intelligent use of the map. Others will require every aid which can be afforded them before the grammar even of the subject is acquired. For many it will only be necessary to read with care the excellent and remarkably clear statements concerning the manner in which contours express elevation which appear upon the inside of the covers of the United States Geologic Folios. Obviously it is not for such students that the aids hereafter to be described were especially designed, though it is thought that even for them individual laboratory study with the apparatus will be of distinct advantage.

A topographic contour map being always an approximation only to a correct representation of the configuration of the country, it may be described in terms (1) of the measure in which it assumes to approach a correct delineation, and (2) the measure of warrant for the degree of correctness assumed. These contrasted ideas are embodied in the terms precision and accuracy. The measure of precision is afforded by the map in its scale and in its contour interval. A map printed on the scale of two inches to the mile, and with a contour interval of ten feet, makes larger assumptions than one printed on the scale of two miles to the inch and with a contour interval of one hundred feet. Though more precise the former may, however, be no more accurate than the latter. Assuming, however, that the map was intelligently, skilfully, and conscientiously made, its accuracy will depend chiefly on how many points there are upon the map whose position and elevation have been determined, since these are the basis upon which the contours have been sketched.

In the case of the most accurate of contour maps, the engineer by means of his transit locates and fixes the altitude of a very large number of points. He then notes at each of these, or at such points as seem necessary for his purpose the direction and the angle of the slope. Contour lines, representing as they do points on the same level, are horizontal and therefore at right angles to the directions of slope. The map maker's task is therefore completed by drawing his contour lines perpendicular to the lines of the steepest slope, and at such distances from the points located as the altitudes and angles of slope at each of the latter require. The simple model and exercise which are to be described aim to put the student in the position of the engineer who makes the map, and, when the work has been completed, to apply a simple test of its accuracy from the use of which the actual map-maker is debarred.

The apparatus for the purpose consists of a box of galvanised iron one foot square upon the bottom and five inches in depth (see Fig. 1) with a $\frac{3}{4}$-inch flange or rim at the top. On each of two opposite sides this rim is provided with a row of stout iron pegs one-eighth of an inch in diameter and three-eighths of an inch in height, and these are set one

inch apart with the terminal pegs in each row half an inch from the side walls of the box. The box is further provided with a small brass faucet set at one corner and low enough to empty it of water to within half an inch of the bottom. Four inches above the bottom, a narrow stripe is painted on all four sides so as to allow of bringing the box to a level position when largely filled with water. There is, further, on one side a series of narrow stripes at half-inch intervals extending downward to the bottom. This gauge is to permit of withdrawing the water from the uppermost level in successive half-inch layers.

An attachment to the box is a stiffened brass strip one inch in

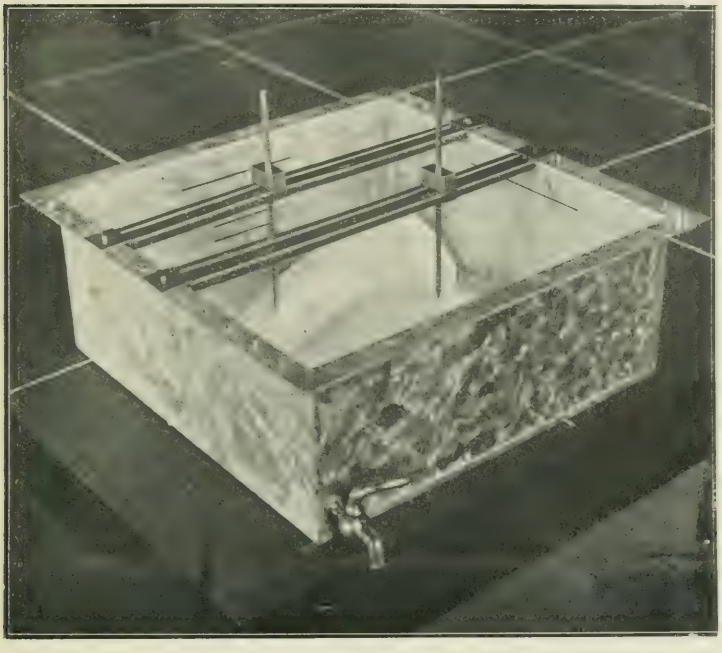


FIG. 1.—An Apparatus for Instruction in the use of Map Contours.

width perforated at each end, and of just such length as to stretch across the top of the box from the peg on one rim to the corresponding one upon the other. This strip, except at the ends where it overlies the flange of the box, is divided lengthwise by a slot. It is further graduated into half-inch intervals and provided with a sliding carriage supporting loosely a vertical rod pointed below and, like the strip itself, graduated into half-inch intervals (see Fig. 2). The sliding of the carriage along the strip, and the movement of the rod upward or downward through its carriage, together permit of bringing the point of the rod to any point in the middle vertical plane of the strip. The transfer of the strip successively from one pair of pegs to each of the others further permits of reaching all points in a series of near-lying, parallel, vertical planes,

and thus, so far as is necessary for our purpose, we may locate the position and fix the altitude of any point within the box. The vertical rod is so graduated that when the point rests upon the bottom of the box, the reading is zero. This is the datum plane corresponding to sea level or any other assumed datum. The figures corresponding to successive half-inch elevations of the rod from the floor of the box are in order 1, 2, 3, 4, etc.

FIG. 2.—The Sliding Carriage and the Vertical Measuring Rod.

Models, constructed of plaster of Paris to represent a portion of the earth's surface, are made of such size as to fit easily within the box. It is well that these be of quite simple character; such, for example, as a volcanic cone, a pair of drumlins, or a simple area of mature erosional topography. To prepare these models a form is first made in artist's modelling clay. This is covered with strips of cotton sheeting, and plaster of Paris put on in a thin coat in order to form a mould, from which, when hard, models may be cast in the numbers needed for class work. The casts are smooth and coated with oil or vaseline in order to keep out the water.

To prepare a topographic map of any desired model, the latter is placed on the floor of the box, and the measuring attachment to the apparatus is fixed in position upon a pair of pegs which will allow the point of the measuring rod to describe a section across one of the margins of the model. Measurements are now made successively at half-inch intervals along this first section, and the readings recorded at corresponding intervals on cross section paper. The direction of slope and its amount may be taken with a small clinometer compass at each observing point or as often as is deemed necessary, the direction being either taken accurately with the compass or estimated with the eye in reference to the sides of the tank. For this purpose it is necessary that the apparatus be oriented so that its sides correspond to the cardinal directions. One section completed, the attachment is moved to the next succeeding row of pegs where a similar process is carried out, and so on successively until all sections have been covered.

With the model still before him the student now begins drawing the contours (see Fig. 3). After such corrections as the instructor can suggest have been made, the box is filled with water to the level of the uppermost stripe. This water is now drawn off in successive half-inch layers, and each contour of the map in turn compared with the temporary shore-line of the model to which it should correspond.

The association of a definite form of model with each map which the student prepares, tends to supply the form element to the map in a way not possible where no similar comprehensive view of surface form is obtained. The section paper used in the exercises, is better chosen with a unit other than one inch, so that the idea of map scale may be gained at the outset through a comparison of this unit with the inch standard

of the apparatus. If alternate contours be first drawn, the comparison of this map with the completed one will show how the shorter contour interval adds detail to the map. Each apparatus may, if desired, be provided with two measuring attachments, and so made available for use at one time by a group of four students, two of whom record the measurements while the others observe. Thus provided with two

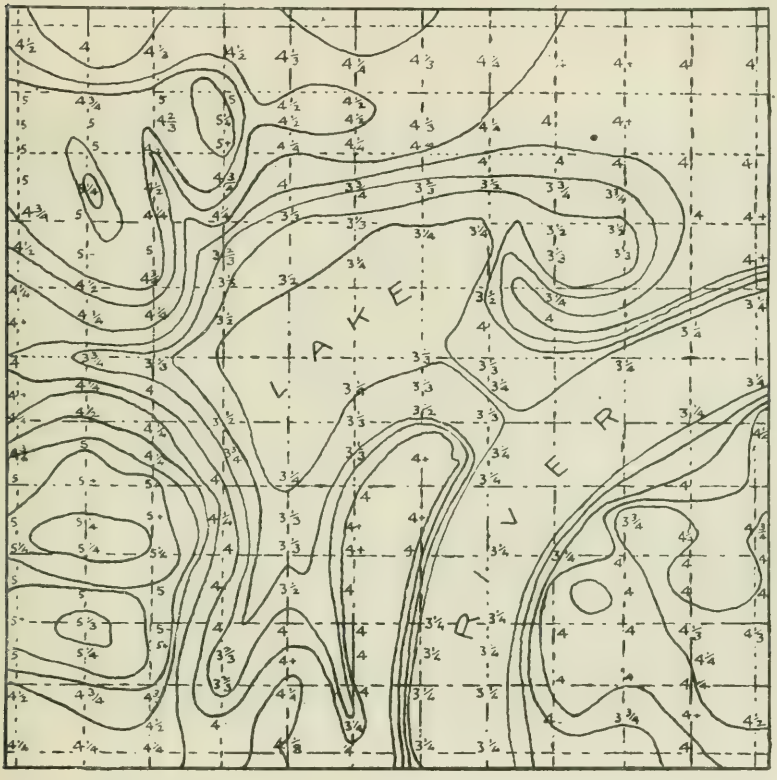


FIG. 3.—A Student's Map on section paper of a simple model of Low Relief.

attachments and exclusive of the plaster models, the apparatus may be constructed in lots of six at a cost of three dollars each.

2. *Mountain Structures.*[1]

Practical structural geology is essentially an exercise in synthesis,

[1] This second part of Professor Hobbs' paper has been included here because, although unlike the first, it does not deal directly with geography, yet the subject is one which the geographer must grasp thoroughly if the problems of earth structure are to be understood. Such a piece of apparatus as is here described may therefore well form an adjunct to a geographical laboratory.—ED. *S.G.M.*

but one which must often be carried out with many of the needed elements missing. In order intelligently to set forth from the incomplete data the actual dispositions and attitudes of the rock layers, a consideration of the types of warped surfaces into which rock layers are thrown in the process of folding, is first of all essential. Where abrupt variations are noted from the curve demanded by the greater number of observations, some special explanation in rock rupture, or faulting, is called for.

Though the student may be shown photographs of anticlines and synclines of the various types as these are illustrated in single rock cliffs or ledges, it is as well that he should know at the outset that these are only rarely to be thus observed, and that much of what we know of the nature of rock folds is derived from a process of patching together in which the scattered observations of dip, strike, and pitch furnish the elements

The difficulties in the way of making clear to students the nature of the dip and strike of rocks, have convinced the writer that the only satisfactory method is to give each student practical drill. Educational institutions which are situated in areas of folded rocks have the best of all opportunities, because the class excursions can be utilised for a study of the strike and dip. Very large numbers of students are found, however, in regions where rock beds lie relatively flat, and still others, like those at the University of Michigan, are surrounded by such thick deposits of glacial material that a journey by rail of a couple of hours is necessary in order to find rock exposed at all. Obviously, then, it is here necessary to supply laboratory drill in structural geology as a preliminary to studies in the field. We are of opinion that even where the best of conditions for field study exist, the laboratory drill as here outlined may be made a valuable adjunct to the excursions.

In order to permit of suitable studies of rock position and attitude, a special laboratory table must be used. For this purpose one of the ordinary type is constructed, but with a separate top which may be taken off whenever the table is to be used for structural studies. Thus denuded of its usual cover, the table presents a top of soft wood painted like a blackboard and divided by narrow white stripes into square sections which can be numbered with chalk on the township plan. In Fig. 4 such tables are shown in use with the tops removed. One of them appears in the foreground with its usual cover, and the removed covers are seen standing against the wall of the laboratory near the entrance door. These covers are strongly braced with cleats and have a flange which fits over the edge of the inseparable top of the table so as to be maintained in position. It is well to place the tables, at least when they are in use for structural studies, so that the section lines correspond to the cardinal directions.

To represent the rock outcrops in the laboratory studies, a simple device which we may call an "outcrop block" has been constructed. This block, which is shown in Fig. 5, is made by sawing out from $\frac{7}{8}$ inch board a rectangle four inches by six, and then sawing from the middle

of one of its narrower edges a rectangular piece one and a half inches deep and two inches broad. This piece is slipped down from its former position within the larger block so that it projects by one-fourth of an inch. A $\frac{1}{4}$ inch hole is then bored through both pieces, keeping to one side of the median plane of the board, and a bolt provided with a washer and wing-nut passed through and fastened. A similar but shorter bolt is passed in a direction at right angles to the first and toward the other side of the median plane through the smaller block, the rounded head of the bolt being accommodated in the free space left between the two blocks. The outcrop block as thus constructed is fixed in any position

FIG. 4.—Laboratory tables in use for studies of mountain structures. The nearer table to the right is arranged to illustrate the relation of varying strike and dip to pitch. The nearer table to the left shows a series of outcrops outlining an unsymmetrical pitching anticline. The farther table to the right illustrates the common types of rock folds. The farther table to the left shows a series of outcrops which illustrate how faults produce offset.

upon the table by merely boring a hole in the top of the table with a $\frac{1}{4}$ inch bit, and passing the projecting portion of the bolt through it. Before tightening the wing-nut the block may be given any desired azimuth (strike) in reference to section lines, which through adjustment of the table have already been made the cardinal directions. By first loosening and then tightening the wing-nut of the horizontal bolt each outcrop block may be given any desired inclination (dip). The broad surface of the block thus represents the surface of a rock layer in the exposure. The position of each block may be described in terms of its distances from the boundary lines of the numbered sections. The blocks

are painted, some white and others Venetian red, so as to represent the different petrographic types—let us say, limestone and red sandstone. A square form of outcrop block four inches on an edge looks somewhat better and is in most respects quite as satisfactory as the larger one, but a compass needle is apt to be affected by the iron bolts when a measurement of the strike is made. Some of the blocks shown in the views are, however, of this size.

An almost infinite number of demonstrations and exercises are possible with the use of this simple apparatus. The various types of synclinal and anticlinal fold—symmetrical, unsymmetrical, and overturned—may be shown in comparison by fastening pieces of stout paper to the outcrop blocks by means of thumb tacks (see Fig. 4 at right), or they may be illustrated successively in a single fold through adjustments in the dip. The relation of stroke and dip to pitch, so difficult to make clear in the absence of models, is here rendered comparatively easy. In Fig. 4 at the right towards the front, a group of outcrops of limestone

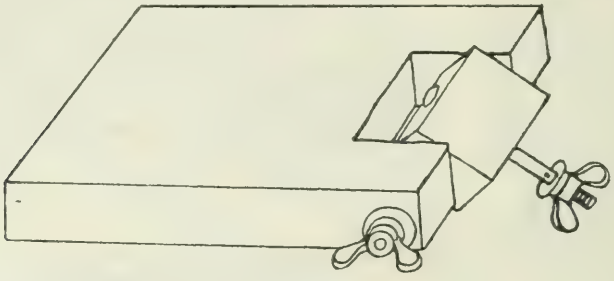


Fig. 5.—An outcrop block.

and overlying sandstone betrays an anticline pitching south (to the left). To bring this out clearly a piece of stiff paper is fastened by thumb tacks to the limestone outcrops and thus restores the missing portion of the fold—the "air saddle." For such a structure the paper is not competent to support its weight, so a strip of poster board is fastened beneath it in the broad portion of the arch attached by brass rivets such as are in use for paper fasteners (the M'Gill type). The relation of the varying strike and dip to the pitch is seldom grasped at a glance, and the student is therefore required to measure and record the dip and strike as well as to determine the location of each outcrop, in order to prepare a map on the basis of his observations. This map is afterward compared with the model (see Fig. 6). Small clinometer compasses are provided for this purpose and the strike observation measured at the top of the block as far as possible from the iron bolts. The observations are taken down on section paper so as to locate each outcrop without the necessity of written notes, the strike and dip being indicated by the T-shape symbols of Dana. A practical problem in the form of a steeply pitching unsymmetrical anticline is represented on one of the nearer tables of Fig. 4, and in the students' notes by Fig. 7.

How the process of folding in rocks shortens the crust and distorts or deforms the beds themselves through the accommodation of layers, is forcibly brought home to the class by the simple device illustrated in Fig. 8. This model is prepared by sawing from a three-inch plank a strip one inch wide in the form of an unsymmetrical anticlinal fold. Two exactly similar piles of strips of white paper an inch in thickness and of the same length as the straightened anticline, are marked on the long edge with a series of tangent circles provided with vertical and horizontal diameters. These circles may represent any structures within the rock beds; let us say, the pebbles of a conglomerate. On

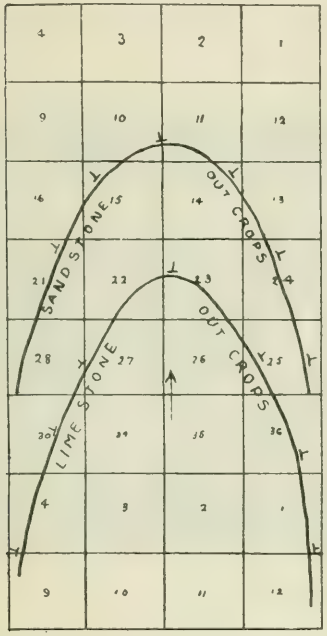


FIG. 6. Students' map of outcrops to show the relation of strike and dip to pitch.

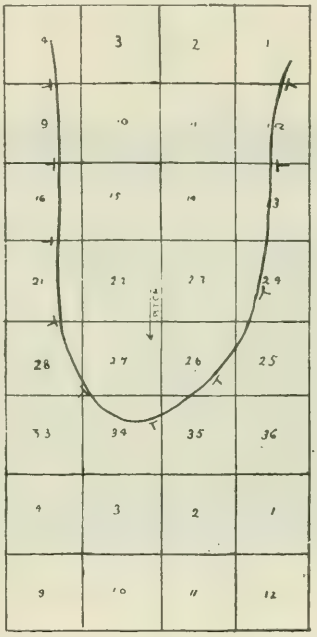


FIG. 7. Students' map of outcrops which outline an unsymmetrical, pitching anticline.

placing now one of the piles of paper in the space cut out from the plank and fastening the two parts of the model together, except within the arch of the folds the circles are changed into ellipses through the accommodation of the sheets of paper just as they would be in rocks through accommodation of the rock laminæ. The greater distortion occurs in the steeper limb of the fold, and the axis of greatest distortion or slide is that which in a more extreme case of folding—a sharply overturned anticline—would develop into a plane of rupture or thrust. The amount of crustal shortening is here indicated by placing the unbent pile of paper beside the folded one. Thus all these more or less complex changes within the rocks in the process of folding are given a striking demonstration without the resort to mathematical treatment. The

student thus learns why, if he is searching for a conglomerate in a region where the rocks have been complexly folded, almost his only chance of finding it is to search in the arches of the anticline where the pebbles have been so little changed as to be still recognisable.

To illustrate the subject of faulting the writer has already described a piece of apparatus [1] in which wooden blocks of different sizes are floated upon water and held in unstable positions through the medium of a vice, so that when the compression is released they at once adjust themselves to their natural positions of flotation to the accompaniment of faulting. The swelling of the wooden blocks used in this experiment soon gave trouble in operating, and the apparatus has since been much improved through the substitution for the wooden blocks of small boxes made from galvanised iron.

The outcrop blocks which have been described above can be used to

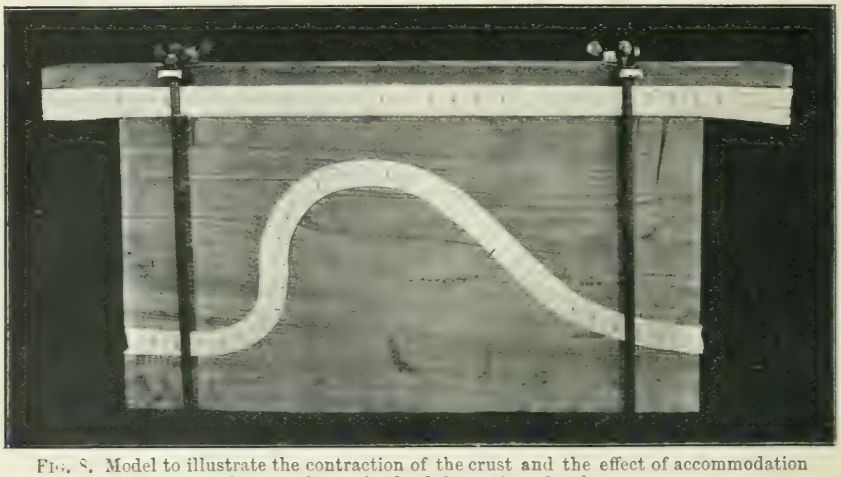


Fig. 8. Model to illustrate the contraction of the crust and the effect of accommodation between layers in the deformation of rocks.

especial advantage in illustrating the subject of faulting, and particularly the effect of faults in offsetting lines of outcrop. The combination of faults with folds may here be made particularly instructive because the portions of the folds once above the present eroded surface may be restored in the paper arches for a clearer understanding of the subject (see Fig. 4).

It is not alone for the purpose of demonstrating the fundamental principles of structural geology that the outcrop blocks here described are adapted. They may serve also in the working out of difficult original problems, and for this purpose several tables may, if required, be placed side by side and the outcrops entered accurately from the field notes. Thus there are brought into a single general view and with the aid of restored air saddles what in the field has been seen in small sections only.

[1] *Earthquakes*, D. Appleton and Co., New York, 1907, pp. 34-36, pl. 3.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

At a meeting of Council held on the 8th July, the Ordinary Diploma of Fellowship was conferred upon Mrs. Adela M. Spoer, Francis Grahame Millar, and Frederick Mort, M.A., B.Sc., F.G.S.

A meeting of Council was held on the 17th November, when the undermentioned ladies and gentlemen were elected Ordinary Members of the Society :—

George MacGregor Richmond.
Miss Clara T. Blackie.
John Watson, B.A. (Lond.)
Miss Elsie Saunders.
John Sharp.
Henry Aiken Anderson, C.S.I.
Miss Jane S. Blyth.
James J. Simpson, M.A., B.Sc.
Miss M. G. Balfour.
Miss Helen F. Myers.
Robert Cross.
William Stewart.
D. Blair, L.D.S., D.D.S.
John Simpson.
Mrs. Paton Gloag.
Thomas Goodall Nasmyth, M.D., D.Sc., D.P.H., F.R.S.E.
James Paterson, C.A.
Miss Jeanie M'Nair.
Miss Lillian E. Pringle.
Miss M. K. Mitchell.
A. Orr Deas, Advocate.
Mrs. S. J. Hay-Newman.
Mrs. Agnes Baxter.
Miss Alice Beattie-Brown.
Robert Wilkie.
Miss E. Hall-Sawers.
Miss A. C. Pringle.
Miss C. B. Hill.
C. G. Potter, B.A.
Miss E. L. Miller.
Mrs. David M'Laren.
Mrs. W. Thomson.
Rt. Hon. Robert Farquharson of Finzean.
Miss Scott.
Athole F. Stewart.
A. W. Anderson.
Mrs. G. P. Boddie.
Mrs. Summers.
R. Carstairs.
Rev. John Young, D.D.
Peter Carmichael.
William Grant.
A. M. Bruce.
Mrs. Somerville.
Miss H. J. Graham.
Miss M. H. Ferguson.
Miss Kinloch of Gilmerton.
Henry Hay, M.B., C.M.
Miss L. Mitchell.
J. Harvey Shand, W.S.
James Clark.
Donald Campbell.
Archibald Young.
Rev. John Gray.
Archibald Bryson.
André Raffalovich.
Henry Macleod Paton.
Harold B. Cox.
Rev. Wm. Macdonald.
Miss Kathleen M. Kirkwood.
Mrs. Blair.
J. Bryan Nisbet.
William Grant.
James Hart.
Thomas Brown Greig.
John Macaulay Bowie, M.D., F.R.C.S.E., M.R.C.P.E.
Lord Peckover of Wisbech.
Miss Sherriff.
Mrs. M. Cameron.
John A. Weir.
Thomas M'Crow.
Mrs. Edward Maxwell.
Robert Whyte Maclay.
John Minty.
James S. Cunningham.
Arthur Herbert Callender.
D. S. Philip.
John Davidson.
Mrs. Law.
Miss H. A. Smith.
J. A. Graham Miller, W.S.
Benjamin Smith.
John S. Wyper.
Miss Watt.
Miss Handyside.
J. M. Williams.

The following ladies and gentlemen were elected Teacher Associate Members of the Society :—

Miss Bella F. Martin.
James Cossar.
Miss J. R. Davidson.
Miss Cecilia Brown.
Miss Margaret Mackenzie.
Miss Mima L. Ewing.
Miss Helen S. Adamson.
Miss Jean G. Thomson, B.Sc.
William Thomson.
Charles Campbell, M.A.
Miss Sophia C. Taylor.
George C. Ligertwood, M.A.
James A. Ramsay.
Miss Margaret S. Adams.
Miss M. A. C. Steedman.
Miss Georgina Crawford, M.A.
Miss Alice Drummond.
Alex. Doull, M.A.
Miss Christian Ewen, M.A.
Archibald M'Laren Smith.
Miss Zimmermann.

Diploma of Fellowship.

The Council conferred the Ordinary Diploma of Fellowship on Mr. J. M. Williams, subject to his compliance with the prescribed conditions.

Society's Silver Medal.

The Council awarded the Society's Silver Medal for 1908 to Lieut. A. Trollé for his explorations in North-East Greenland.

Annual Business Meeting.

The annual business meeting of the Royal Scottish Geographical Society was held in their new rooms in the Synod Hall, Edinburgh, on November 17th—Professor Geikie presiding. The Chairman said that was their first meeting in their new rooms, and he thought he expressed the feelings of all the members in saying that the change was for the better. The annual report (see pp. 669-72) was submitted by Major Forbes (the Secretary). Mr. Currie, Honorary Treasurer, presented the financial report, and stated that the expenditure had decreased by £168, but unfortunately the receipts had also diminished from £1875 to £1517, mainly due to members being in arrears with their subscriptions.

Professor James Geikie was re-appointed President. The Hon. Lord Salvesen was elected a Vice-President. The following members of Council who retire by rotation were re-elected :—

Lieut.-Colonel F. Bailey; James J. Dobbie, M.A., D.Sc., F.R.S.; J. Horne, LL.D., F.R.S.; H. B. Finlay; William B. Wilson, W.S.; John Gunn, M.A., D.Sc.; Sir James A. Russell, LL.D.; H. M. Cadell, B.Sc.; A. P. Laurie, M.A., B.Sc., F.R.S.E.; Paul Rottenburg, LL.D. (Glasgow); Robert Fullerton, M.D. (Glasgow); I. Julius Weinberg, J.P., F.R.G.S. (Dundee); Alexander Mackay, C.A. (Dundee); John Clarke, M.A. (Aberdeen); and William Smith (Aberdeen).

The following members of the Society were elected to fill vacancies on the Council :—George G. Chisholm, M.A., B.Sc. (Edin.), F.R.G.S.; J. Stewart-Clark; Major-General P. C. Dalmahoy; J. Edward Graham, B.A. (Oxon.); James Macdonald, W.S.; Colonel Sir Philip Durham Trotter; Sir Donald Macalister, K.C.B., M.D., M.A., D.C.L., B.Sc., F.R.C.P., F.R.G.S., Principal of the University of Glasgow; and Henry Dyer, D.Sc. (Glasgow).

The Chairmen of the Glasgow, Dundee, and Aberdeen centres were re-elected.

Eighty-six ordinary members and twenty-one associate members were elected.

Sir Colin Macrae, in moving the adoption of the reports, said it was just twenty-four years since the Society was instituted, and it had amply justified its existence. The Government grant showed that they were looked upon in the highest quarters as a scientific body. Their course of lectures was not surpassed by any in the country. He congratulated the Society on the acquisition of the new rooms in which they were met. Their new scheme of opening the rooms in the evenings for school teachers would have a beneficial effect in the facilities which would be afforded to those teachers for increasing their geographical knowledge.

The Secretary announced that the Council had decided to award the Society's silver medal to Lieutenant Trollé, the master of the vessel which carried the North-East Greenland Expedition.

Lectures in December.

Major F. G. Guggisberg, C.M.G., R.E., will lecture before the Glasgow centre on the 7th inst. on "The Survey of the Gold Coast and

Ashanti." On December 8th at Aberdeen, F. E. Tillemont-Thomason, F.Ph.S., C.E., will deliver an address entitled "The Wealth and Glories of the West Indies"; Walter Preedy, Commercial Agent for the New South Wales Government, will deliv . a lecture before the Dundee centre entitled "Australia To-day"; Lieut. A. Trollé will address the Society in Edinburgh on the 10th December on the Danish North-East Greenland Expedition. The Christmas lecture in Edinburgh will be delivered by Miss E. G. Kemp on the 22nd. The lecture will be entitled "Across China by Road, River, and Rail." This lecture will be fully illustrated by a number of water-colour and pen-and-ink sketches. W. H. Shrubsole, F.G.S., will deliver the Christmas lecture at Glasgow, Aberdeen, and Dundee on the 21st, 23rd, and 24th respectively. "Hungary and the Hungarians" will be the subject of his lectures.

GEOGRAPHICAL NOTES.

Polar.

Captain Amundsen's New Arctic Expedition.—Captain Amundsen's plans for a new North Polar expedition are now assuming definite shape. Captain Amundsen's scheme is a modification of that which Dr. Nansen carried out on his voyage in the *Fram*. The *Fram* was frozen in the ice to the north-east of the Lena Delta, and drifted nearly up to the 86th parallel. It is thought that a vessel entering the ice further to the east would drift further north and possibly over the Pole itself. Accordingly Captain Amundsen proposes to enter the North Polar basin through Behring Straits, and to fasten his ship in the ice off Point Barrow, on the Alaskan coast. The expedition will be fitted out for a voyage of five or six years, and will be specially equipped for the work of oceanographical investigation. The Norwegian Government is very favourably disposed to the enterprise, and in all probability the *Fram* will be thoroughly overhauled and placed at Captain Amundsen's disposal for the purposes of his expedition. Captain Amundsen intends to start early in 1910, and will proceed to San Francisco, where he will embark coal and provisions, sailing thence to Cape Barrow.

General.

Glacial Erosion.—In the proceedings of Section E (Geography and Geology) of the Winter Meeting of the American Association for the Advancement of Science, reported in *Science* for May 8, several papers dealt with the question of glacial erosion. Thus Professor W. M. Davis discussed the mountains of North Wales, and expressed the opinion that these mountains retain in part forms little changed from those which are not producible by normal erosion, but which are eminently characteristic of the forms that glaciers would produce if they were eroding agents. Professor Davis considers, however, that an acquaintance with the forms producible by normal (*i.e.* non-glacial) agencies is necessary

before the abnormality of the conditions existing in North Wales can be appreciated. According to him, it is the absence of such normally eroded mountains in Western Europe which has delayed the recognition by European geologists of the glacial origin of a number of abnormal features in these mountains.

Mr. Warren Upham also read a paper on the fiords of Puget Sound and the Saguenay. Puget Sound with its many long and narrow arms called canals, from 100 to 600 feet in depth beneath the sea-level, are, he states, admirable examples of fiords opening northwards, and thus running towards the interior of the ice-sheet which, during the glacial period, covered this district, and which was the southern part of the continental ice-sheet west of the Rocky Mountains. These fiords cannot be regarded as due to glacial erosion, because they run in courses opposed to the courses of glacial erosion and transportation of material eroded.

The Saguenay Fiord, which is 60 miles long and river-like in its nearly uniform width and somewhat winding course, has a depth of 500 to 900 feet below sea-level, and is continuously enclosed on each side by precipitous bluffs and cliffs 500 to 1500 feet in height. It is to be regarded as a typical fiord of the Norwegian type. Both the fiords of Puget Sound and of the Saguenay, Mr. Upham believes, have been produced by fluviatile erosion prior to the Ice Age, and together with other fiords further north they show that the American continent was considerably elevated prior to the great glaciation. The author believes that this elevation was the cause of the accumulation of snow and ice, and thus of the Glacial Period.

Personal.—At the opening meeting for this session of the Geographical Society of Geneva, Miss Marion Newbigin, Acting Editor of the *Scottish Geographical Magazine*, was appointed a Corresponding Member of the Society.

EDUCATIONAL.

We have received recently from Messrs. Philip and Son a Relief-Model of a part of the boundary between the Highlands and Lowlands of Scotland, comprising the northern part of the Clyde basin, and including the Lochs Lomond, Gareloch, Long, and Eck, with parts of Katrine and Fyne. Roughly, the relief covers the western portion of Section xv. in Bartholomew's *Atlas of Scotland*. The relief sent to us, which is neatly mounted in a black frame, is coloured orographically, three colours being employed—below 750 feet is green, below 2500 feet brown, while the hill-tops above this limit are left white. The horizontal and vertical scales are the same, so that there is no exaggeration of slope, and the scale is two miles to an inch. The lochs are coloured blue, but with the exception of the Clyde estuary the rivers are not marked. The model is accompanied by a small explanatory pamphlet, both model and pamphlet having been prepared by Mr. Russell F. Ginnell. The district

selected is an interesting one, and teachers will find the model useful for many purposes. Mr. Ginnell in his pamphlet, which is illustrated by a geological map, has confined himself to an exposition of the simpler topographical features, and hardly touches upon what many would call the really geographical side—that is, the relation of the relief to human activities in the area—but the model could be used for many interesting lessons from this standpoint. For this reason we are a little disposed to regret that more of the Glasgow area is not represented, in order that the teacher might drive home more surely the differences in economic development between Highlands and Lowlands and the causation of these. Even on the small area represented, however, many important points as to the causation of the exact position of towns, the course of railways and roads, may be well brought out by the use of the model. In addition it could be usefully employed, as suggested by the accompanying pamphlet, to explain the meaning of geographical terms. More especially it shows well that the mountains of Scotland have been produced by the long-continued erosion of an almost plane surface; the meaning of the statement that the sea-lochs of Scotland are merely drowned river-valleys is also well illustrated. Another very interesting point is the peculiar nature of the water-partings, notably that between Loch Katrine and Loch Lomond, which show beautifully the features dwelt upon by Professor Tarr in his paper published here last month (p. 579). The teacher will not fail to note how well the relief illustrates Professor Tarr's statement that these "through valleys" are of great assistance in connection with the development of means of communication.

We have received from the Diagram Company two excellent specimens of their Orographical Hand Maps. The one is North England, the map being divided into forty-mile squares, and having the county boundaries shown lightly. The other is The Tyne Gap, and is on a larger scale, being divided into ten-mile squares. In this map the rivers are shown, and the main roads are indicated by a dotted line. In both maps the position of the towns is indicated, but no names are given. The maps seem to us of great educational value, and even a casual glance suggests a great number of valuable exercises for which they might be used. The map of the Tyne Gap especially, showing as it does among other interesting points the "high and the low road" into Scotland, could be used for some very vivid lessons. The maps can be purchased for 1s. a dozen, a price which should admit of very general use.

We have received through Mr. Crosbie Turner, the hon. local secretary of the Glasgow Centre, a letter from Dr. Bottomley, 13 University Gardens, Glasgow, stating that Dr. Bottomley will be glad to send to any members of the Society who may desire them tickets of admission to the Blythswood Laboratory. In this laboratory the collection of instruments, etc., which belonged to the late Lord Blythswood are displayed. Members desiring to avail themselves of this kind offer should apply to Mr. Crosbie Turner, in Glasgow.

NEW BOOKS.

EUROPE.

Historical Geography on a Regional Basis. Vol. II.—Europe. By Ernest W. Dann, B.A. (Oxon.). London: J. M. Dent and Co., 1908. *Price* 2*s.* 6*d.*

The first volume of this work was noticed in our August number. The general opinion then expressed is on the whole confirmed, but we are conscious that the inevitable weaknesses of the work are more apparent than they were in the previous volume. The Historical Geography of Europe is too large and too complex a subject for treatment in so small a book, and on the whole we confess to some feeling of disappointment. The assumption of previous knowledge is here almost necessarily much greater than in the previous volume; indeed, a student would need to have a very full and exact knowledge of the history and of the topography of Europe before he could keep within sight of the author, as the text rapidly passes from one part of the story to another; and a student so equipped would probably find this book lacking in sustained interest or helpfulness. After all, history is a story, and needs connection and continuity for its due understanding and appreciation. It is, of course, true that history cannot be properly treated apart from the geography on which it is largely based, but this really only means that before the study of any section of history is entered upon, the geographical factors involved should be mastered. The Historical Geography of Europe would need a much larger volume than the one now under consideration, and also an apparatus of large-scale maps of very different character from the small black-and-white ones herein contained.

Pentland Walks, with their Literary and Historical Associations. Compiled and Edited by Robert Cochrane. Edinburgh: Andrew Elliot, 1908. *Price* 1*s.*

This is an interesting and useful little book, well illustrated with photographs and simple route maps, which is especially strong on the literary and historical associations of the Pentlands. The instructions for finding the roads seem to us slightly lacking in the precision necessary for those to whom the ground is not already familiar, but those who know the hills well will find here many interesting facts and notes. The geology is somewhat fully treated, as is only right in a book published in a city famous for its geologists, and there is also a chapter on the birds of the hills.

Russia's New Era. By R. G. Barrett, F.R.G.S., Editor of *The Financier and Bullionist.* Published at its Office in London, 1908. *Price* 6*s.*

The author made in 1907 a tour of several months in European Russia and Siberia to observe the condition of the people and to report impartially on what he saw. His chief object was to ascertain the prospects of British commerce and the openings for British capital. During an interview which he details, he received from the Minister of Finance (M. Kokovotzov) a full and illuminating account of the condition and prospects of the Russian Empire, and he found that that Minister's financial difficulties had greatly transcended those of any Chancellor of the Exchequer. Mr. Barrett formed a high opinion of the Czar and his Prime Minister (M. Stolypin).

After several financial chapters, the author gives one on "Russian Trade Openings," and states that "Russia with its vast expanse of territory offers the

British manufacturer an unlimited market," but mentions that, although Russians are honest traders, the usual credit they expect is twelve months. A description of the physical and political features of Russia follows, and the distribution of population in 1905 is stated as 18,366,800 urban, and 125,603,300 rural, showing the immense importance of agriculture in Russia. State forests cover 948 millions of acres.

With regard to the towns, the populations of St. Petersburg and Moscow both exceed a million, and that of Warsaw exceeds 750,000, while Odessa has 449,000 inhabitants, Lodz 351,000, Kieff 319,000, and Riga 282,000. In appearance St. Petersburg is mainly modern, with more than 400 churches and a dozen palaces. Moscow is magnificent and picturesque, but with cotton mills as good as any in Lancashire. Owing to its central position, Moscow, the ancient capital, bids fair to be the real capital of Russia. Warsaw is a very handsome and animated city with 150 palaces of the old Polish nobility. It is becoming the industrial centre of Western Russia. Nijni Novgorod is renowned for its Fair, and Kieff has a University attended by 3000 students.

There are in Russia over 41,000 miles of railway, whereof 28,000 belong to the State. While Russia produces 90 per cent. of the world's platinum, and a large part of its petroleum, her copper and iron deposits are extensive and valuable. Mr. Barrett, however, declares that "Siberia is the country of the future. Its vast natural wealth is just being made known." He visited three of its gold and copper properties. German and British exports from Russia are of about equal value, but the German imports to Russia are nearly treble the value of the British.

Prior to the Crimean War, the friendship between Britain and Russia had almost become a tradition, and now that the two countries are friendly once more, Britain should benefit by the expansion of Russian trade and industries. Mr. Barrett's book is valuable as containing the unprejudiced opinions formed on the spot by a business man and financial authority. It includes good portraits of the Czar and some of his Ministers, and interesting views of St. Petersburg, Moscow, etc.

Valladolid, Oviedo, Segovia, Zamora, Avila, and Zaragoza: An Historical and Descriptive Account. By Albert F. Calvert. With 413 Illustrations. London and New York: John Lane and Company, 1908.

"The province of Asturias is, for all men of Spanish blood, holy ground," says Mr. Calvert in his chapter on Oviedo, and we may take this as the key-note to this latest addition to his "Spanish Series." For the author takes his readers this time to visit some of the old fortress towns in that part of northern Spain between Madrid and the Pyrenees, which was for so long the battlefield between the Moors and the Spaniards. It constituted the borderland, the Marches, so to speak. Cities changed hands with bewildering frequency and amidst scenes of unspeakable ferocity. They lived, like their citizens, "in full armour," and here the Goth was developed into the Spaniard. Truly it is "holy ground."

Each city is full of interest. Valladolid, where Cervantes lived and wrote, and where the grim scenes of the Inquisition took place; Avila, the home of Santa Teresa, and Zaragoza, with its immortal memories. But interest will centre in Oviedo, for here it was that the Spaniard turned at last and began that long fight which ended at Granada. As might be expected, the architecture of these northern towns shows less of the Moorish influence than is found in the south. Here we see rather the transition from the Latin to the Spanish Gothic. We think that if anything the wealth of illustration is overdone. 413 pictures to 162

pages of letterpress is rather out of proportion, but this is a very small defect in a most readable book.

Chateau and Country Life in France. By Mary King Waddington. London: Smith, Elder and Co., 1908. *Price* 10*s.* 6*d. net.*

The authoress was born in America, and describes most gracefully the chateaux which she and her distinguished husband, once French Prime Minister and afterwards Ambassador to London, visited during their holidays in France. Although life in these chateaux bore a general resemblance to that in many great British country houses, the authoress notes with skill and perspicuity where it often materially differed. Her husband occupied one of these chateaux when the victorious German army was advancing on Paris in 1870. Absorbed in melancholy reflections, he was sitting in his library one evening about dusk, when he suddenly felt that some one was looking in at the window. "He rose quickly, going to the window, as he thought one of the village people wanted to speak to him, and was confronted by a Pickelhaube and a round German face flattened against the window-pane. He opened the window at once, and the man poured forth a torrent of German, which M. Waddington fortunately understood." She adds: "It was wonderful what exact information the Germans had. They knew all the roads, all the villages and little hamlets, the big chateaux, and most of the small mills and farms." The Germans knew the geography of France probably much better than did the French themselves. The Waddingtons also visited the "Home of Lafayette," an ancient chateau belonging to his great-grandson, the Marquis de Lasteyrie, who married an Englishwoman. Chapters on "Country Visits," "Winter at the Chateau," "Ceremonies and Festivals," "Christmas in the Valois," "A Racine Celebration," and Norman recollections complete (with beautiful etchings) a volume which, while solidifying the *entente* with France, will be found especially interesting to ladies.

AFRICA.

Pleasure and Problem in South Africa. By Cecil Harmsworth, M.P. With 24 Illustrations reproduced from Photographs. London: John Lane, 1908. *Price* 5*s. net.*

South Africa has its pleasures, and it certainly has its problems. The former each can estimate according to his tastes; the latter require the patience and the perception of far-seeing and courageous statesmen. Mr. Harmsworth combines a glimpse at the two in his interesting volume. In the "Pleasure" part his descriptions are excellently done, for he possesses an observant eye and a graceful, racy style. The "Problem" portion stirs the critical faculty, but this follows from their very definition. The Compound system, the Indian invasion, the Federation of the States, are all bristling with perplexities. The author frankly acknowledges that the political views expressed may not be free from partiality. But who can speak with absolute impartiality on matters in South Africa that have been the subject of passionate controversy during the past ten or fifteen years? Still Mr. Harmsworth picks his steps carefully, and gives good reasons for the views he urges. The pressing problem of the time is the government of the country—should there be a Federation of the States or unification? A closer union is eminently desirable, so as to secure one railway and one fiscal policy. Mr. Harmsworth states the case clearly and forcibly for a Federation of the States. The book is brightened by a number of

excellent photographs, and for geographical purposes draws one nearer the great Continent.

AMERICA.

The Falls of Niagara: Their Evolution and Varying Relations to the Great Lakes; Characteristics of the Power, and the Effects of its Diversion. By Joseph William Winthrop Spencer, M.A., Ph.D., F.G.S. Canada: Department of Mines, Geological Survey Branch.

Niagara Falls, the greater part of which is within the Dominion of Canada, have lately been investigated with great care and minuteness by Dr. J. W. Spencer under the auspices of the Canadian Geological Survey. The physical, geological, and economic interest attaching to the past and future history of Niagara will increase as time goes on, and the author in this extremely valuable monograph gives a full account of our present knowledge of the subject, much of which is the result of his own original reasoning from data obtained by himself and other workers during recent years.

The International Boundary Line as determined by the Commission of 1819 throws the whole of the great crescent of the Falls into British territory, and the withdrawal of water for power purposes is drying up the shallower American side, so that only seven per cent. of the water now flows over the American Falls.

The recession of the Falls between 1842 and 1905 is estimated by the author at 285 feet in the centre, the whole gorge having been eaten back to a mean distance of 265 feet in that period, or, on the average, 4.2 feet per annum. For the last fifteen years, however, this rate has been greatly reduced, principally no doubt on account of the large supply of water drawn off through the subterranean channels of the electric power works on the American side. At present the level of Lake Erie is 326 feet above Lake Ontario, but there was a time in the history of the Niagara river when this difference of level was about 500 feet. This is proved by borings which have disclosed an ancient gorge, buried under débris, which entered Ontario 183 feet beneath the surface of the modern lake.

The author has not only collected a body of valuable information about the ancient river system of the district from the records of well borings, but he has himself bored for purely scientific purposes, and has thus succeeded in establishing the existence of a pre-glacial cañon extending from the well-known Whirlpool in the Niagara river to St. David's at the foot of the great escarpment overlooking Lake Ontario. It was the reopening of a fragment of this ancient valley as the modern Falls continued to recede, that gave rise to the elbow in the Niagara at the Whirlpool and added this mysterious and picturesque feature to the course of this beautiful river.

In one of the bores in the bed of the "Whirlpool St. David's Channel" a curious phenomenon was observed. On page 135 we read: "Boring No. 1 was found to be a breathing well. Upon reaching a depth of 226 feet, when the end of the pipe was in the coarse gravel bed, an inward suction was observed. At this point it was deemed necessary to dynamite the end of the casing in order to insert a smaller tube, as the outer casing had become bent in the gravel. Immediately after the explosion, and for another day or two, a strong inward draught continued. Subsequently, at a time when the water in the Whirlpool was particularly high, there was an outward current amounting to a blast. So strong were these currents it seemed hardly possible that such could occur except in proximity to fissures in adjacent rock. However, as the continued borings showed the absence of rock, this breathing appeared to be due to the character of the

porous gravel, not associated with caverns, and depending upon atmospheric conditions, and the height of the river in the Whirlpool. As the deeper borings were made when the temperature was below freezing point, water poured into the inner casing froze into solid ice at the depth of 226 feet, on account of the suction of the cold air between the outer and inner casing."

The numerous well borings in the Province have enabled the author to trace the courses of other pre-glacial valleys where no rivers now exist. Among these he has discovered the original outlet of Lake Erie, which he has named the Erigan channel, the bed of which is at places more than 250 feet below the present surface of the Lake. This buried valley is roughly parallel to and about twelve miles west from the modern Niagara at the Falls, and in pre-glacial times must have been occupied by a river of immense volume.

Dr. Spencer's work is full of other highly interesting particulars which space will not permit us to quote further. He is to be congratulated on the publication of the results of many years of laborious investigation, and this monograph supplies a mine of useful material for all who are interested in the study of physical geography generally and the origin of the surface features of that part of America in particular.

GENERAL.

A Rational Geography. By Ernest Young. Part iii. London: George Philip and Son, Limited, 1908. *Price* 1*s.* 6*d.*

This is the concluding part of the geography book reviewed in our May issue (p. 275), and deals with Scales and Direction, Surveying, Projections, Geology, Flora and Fauna, Asia and Australasia. The present part follows the same line as those of the preceding. The section on surveying seems to us too short to be of very much use; the instruments used are not fully described, and we doubt if either an uninstructed teacher or a pupil could make much of them. As in the previous parts also, we note that the author is especially uncertain in his treatment of plants and animals; it is very regrettable that such a statement as that the platypus is "part bird and part mammal" should have been allowed to find an entrance. We find it also difficult to understand what is meant by the statement that "wheat and rye will ripen at a temperature between 0° and 1° C." The late Dr. Buchan, it will be remembered, showed that in Scotland a mean summer temperature of 56° F. (13.3° C.) is in the general case necessary for the profitable cultivation of wheat. The very title of the chapter in which the above statement occurs—"Distribution of Flora and Fauna," seems to us likely to lead to the wrong use of words; why not merely distribution of plants and animals? On the other hand, it must be said that the book contains a very large amount of information, and that in most cases an attempt is made to directly associate the products of a country and the course of its development with the physical conditions. The large number of questions and problems given at the ends of the chapters should also be of great use to teachers in suggesting lessons and methods of approaching difficult subjects.

Applied Geography: A Preliminary Sketch. By J. Scott Keltie, LL.D. Second Edition. London: G. Philip and Son, 1908. *Price* 2*s.* 6*d.*

Originally published in 1890, the new edition of this very readable and instructive little work gives us it in a thoroughly revised shape, many sections having had to be rewritten owing to the recent changes caused by the activity of the "ruling nations in developing the resources of the lands of the globe, and in annexing

such areas as were available for the purpose." An entirely new chapter has been added entitled "The Unstaked Globe," in which the author informs us that "Commercially, with the exception of Europe, the lands of the globe have been little more than scratched; of the whole commerce of the globe, Europe, the smallest of the continents except Australia, absorbs three-fourths." There is one statement, however, in this chapter to which we must take exception, viz. "The thread that binds Canada to the British Empire is of the most fragile character." Those who have visited Canada and observed the warm sentiments towards the Mother Country entertained by the Canadians, and who know the sacrifices made by them for the British Empire during the recent war, will find it difficult to accept this statement.

Commercial Geography. By Henry Gannett, Carl L. Garrison, and Edwin J. Houston. New York: American Book Company. London: George Philip and Son, 1908. *Price* 6*s.*

This is a very comprehensive little book, copiously illustrated with maps, diagrams, and process blocks. It is divided into three sections—(1) Commercial Conditions, (2) Commercial Products, and (3) Commercial Countries. The width of the range may be indicated by noting that in the first division we have not only a consideration of the usual factors, such as climate, topography, means of transport, etc., but also brief discussions of such topics as plant migration, heredity, emigration, safety signal systems on railways, wireless telegraphy, and so on. The only objection to this excessive comprehensiveness in so small a book is that it necessarily involves a cursory treatment of many important matters. In some instances, indeed, the explanations and descriptions are so short that we cannot believe that they can be of any great value to the student. We have noted several cases of careless writing. Thus the author of the statement on p. 261 to the effect that in Great Britain "both temperature and rainfall are greater on the western than on the eastern coasts," has entirely ignored the essential points as regards temperature in these islands. Similarly the statement that cereals are members of the grass family, and the simultaneous inclusion, without any saving clause, of buckwheat among the cereals, is not justifiable. This point may seem trifling, but as it is expressly stated that buckwheat is grown in the United States as a honey-plant for bees, the implied statement that it is a grass will certainly puzzle an intelligent student.

BOOKS RECEIVED.

We have received the following books and reports:—

Chateau and Country Life in France. By Mary King Waddington. Demy 8vo. Pp. 333. London: Smith, Elder and Co., 1908. *Price* 10*s.* 6*d. net.*

The Inner Life of the United States. By Monsignor Count Voy de Voya and Luskod, Apostolic Protonotary, P.D.H.H., K.C.I.C. Demy 8vo. Pp. xv + 450. London: John Murray, 1908. *Price* 12*s. net.*

The Story of Majorca and Minorca. By Sir Clements R. Markham, K.C.B. With two maps. Demy 8vo. Pp. x + 309. London: Smith, Elder and Co., 1908. *Price* 7*s.* 6*d. net.*

Lands Beyond the Channel: An Elementary Study in Geography. By H. J. Mackinder, M.A. Crown 8vo. Pp. xii + 276. London: George Philip and Son, Ltd., 1908. *Price* 1*s.* 9*d.*

Handbook of Geography: Descriptive and Mathematical. By EMIL REICH. In two volumes. Small 4to. Pp. Vol. I. xx + 568; Vol. II. xxiv + 171. London: Duckworth and Co., 1908. *Price* 12*s.* 6*d. net.*

Dan to Beersheba: Work and Travel in Four Continents. By ARCHIBALD R. COLQUHOUN. Demy 8vo. Pp. xviii + 348. London: Wm. Heinemann, 1908. *Price* 8*s.* 6*d. net.*

The Fijians: A Study of the Decay of Custom. By BASIL THOMSON. Illustrated. Demy 8vo. Pp. xx + 396. London: William Heinemann, 1908. *Price* 10*s. net.*

In Search of a Polar Continent, 1905-1907. By ALFRED H. HARRISON. With illustrations and map. Demy 8vo. Pp. ix + 292. London: Edward Arnold, 1908. *Price* 12*s.* 6*d. net.*

Russia's New Era; being Notes, Impressions, and Experiences—Personal, Political, Commercial and Financial—of an extended Tour in the Empire of the Tzar. By R. J. BARRETT, F.R.G.S. With statistical tables, portraits, snapshots, and other illustrations. Royal 8vo. Pp. xi + 292. London: "The Financier and Bullionist, Ltd," 1908. *Price* 6*s.*

The Imperial Gazetteer of India. Vols. 19-24. New Edition. Complete in 26 volumes. Cloth. Oxford: Clarendon Press, 1908. *Price* £5.

Nautical Charts. By G. R. PUTNAM, M.S. Demy 8vo. Pp. viii + 162. 49 figures. New York: J. Wiley and Son, 1908. *Price* 8*s.* 6*d. net.*

Canadian Life as I found it. By HOMESTEADER. Crown 8vo. Pp. 144. London: Elliot Stock, 1908. *Price* 1*s.* 6*d. net.*

The Other Americans: the Cities, the Countries, and especially the People of South America. By ARTHUR RUHL. Illustrated. Demy 8vo. Pp. xii + 321. London: T. Werner Laurie, 1908. *Price* 8*s.* 6*d. net.*

The Far East Revisited: Essays on Political, Commercial, Social, and General Conditions in Malaya, China, Korea and Japan. By A. GORTON ANGIER, with a Preface by Sir ROBERT HART, Bart., G.C.M.G. Demy 8vo. Pp. xii + 364. London: Witherby and Co., 1908. *Price* 10*s.* 6*d. net.*

Egypt and the English: Showing British Public Opinion in Egypt upon the Egyptian Question; with chapters on the success of the Sudan and the delights of Travel in Egypt and the Sudan. By DOUGLAS SLADEN. With 40 illustrations and a map. Royal 8vo. Pp. xxviii + 568. London: Hurst and Blackett, 1908. *Price* 21*s. net.*

Along the Rivieras of France and Italy. Written and illustrated by GORDON HOME. ("Old World" Travel Series.) Square medium 8vo. Pp. xii + 328. London: J. M. Dent and Co., 1908. *Price* 7*s.* 6*d. net.*

Handbook of Commercial Geography. By GEORGE G. CHISHOLM, M.A., B.Sc. (Edin.). Seventh Edition, with an additional chapter on Trade Routes. Demy 8vo. Pp. l + 660. London: Longmans and Co., 1908. *Price* 15*s. net.*

A Wandering Student in the Far East. By the EARL OF RONALDSHAY, M.P. 2 Volumes. Demy 8vo. Pp. Vol. I. xx + 317; Vol. II. x + 360. Edinburgh: Blackwood and Sons, 1908. *Price* 21*s. net.*

The Exploration of Egypt and the Old Testament. By J. GARROW DUNCAN, B.D. With 100 Illustrations. Demy 8vo. Pp. 248. Edinburgh: Oliphant, Anderson and Ferrier, 1908. *Price* 5*s. net.*

The Face of the Earth (Das Antlitz der Erde). By EDUARD SUESS. Translated by Hertha B. C. Sollas under the direction of W. J. Sollas. Volume III. Imp. 8vo. Pp. viii + 400. Oxford: The Clarendon Press, 1908. *Price* 18*s.*

Hindustan, Indische Reiseeindrücke. Von ERNST HENGSTENBERG. Demy 8vo. Pp. xii + 191. Berlin: Dietrich Reimer (Ernst Vohsen), 1908. *Preis* 8 *M.*

Tunis, Kairouan and Carthage. Described and illustrated with Forty-eight Paintings. By Graham Petrie, R.I. Large 4to. Pp. xii + 252. London: William Heinemann, 1908. *Price* 16*s. net.*

The Commercial Products of India: Being an Abridgment of the Dictionary of the Economic Products of India. By Sir George Watt, C.I.E., M.B., C.M., LL.D., F.L.S. Published under the Authority of His Majesty's Secretary of State for India in Council. Imp. 8vo. Pp. viii + 1189. London: John Murray, 1908. *Price* 16*s. net.*

The Heavens and their Story. By Annie S. D. Maunder and E. Walter Maunder. Demy 8vo. Pp. 357. London: Robert Culley, 1908. *Price* 5*s. net.*

The Greatness and Decline of Rome. Vol. iv. *Rome and Egypt.* By Guglielmo Ferrero. Translated by Rev. H. J. Chaytor, M.A. Demy 8vo. Pp. 291. London: William Heinemann, 1908. *Price* 6*s. net.*

British Mosses. By the Right Hon. Sir Edward Fry, G.C.B. Second Edition. Crown 8vo. Pp. 72. London: Wetherby and Co., 1908. *Price* 1*s.* 6*d. net.*

Hungary: A Sketch of the Country, its People, and its Conditions. By Julius de Vargha. Demy 8vo. Pp. 81. Budapest: Office of the *Athenæum*, 1908.

Practical Geography. Part. i. By J. F. Urstead, M.A. Crown 8vo. Pp. 120. Oxford: Clarendon Press, 1908. *Price* 1*s.* 6*d.*

L'Afrique du Nord. By Henri Lorin. In 18 jésus. Pp. ii + 418. Paris: Librairie Armand Colin. 1908. Price 3 frs.

Punjab District Gazetteer. Sirmur State, Bahawalpur State, Sialkot. Lahore, 1908.

Central Provinces Gazetteer. Nimar District. Allahabad, 1908.

District Gazetteers of the United Provinces of Agra and Oudh. Ballia District. Allahabad, 1908.

Eastern Bengal District Gazetteers. Chittagong District. Calcutta, 1908.

Madras District Gazetteers. The Nilgiris District. Madras, 1908.

North-West Frontier Province District Gazetteers. Hazara District. London, 1908.

Third Report (Northern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1904-1907. London, 1908.

Trading in the Early Days. By H. Ling Roth. Crown 8vo. Pp. 45. Halifax: F. King and Son, Ltd., 1908. *Price* 1*s.*

A Tour in the Far East. By Captain Charles Slack, F.R.G.S. London, 1908.

Onzième Congrès International de Navigation. St. Petersburg, 1908.

Voie Navigable Marie, Entre Rybinsk sur Volga et St. Petersburg. St. Petersburg, 1908.

La Néva et les Canaux du Ladoga. Par Adrien Khonsky. Pp. 25. St. Petersburg, 1908.

Ports de Commerce de la Russie d'Europe. Aperçu general, Mer Blanche, Mer Noire, Mer Baltique et Mer d'Azov. Ministère du Commerce et de l'Industrie Direction des Ports de Commerce. St. Petersburg, 1908.

Les Voies Navigables en Finlande. Pp. 53. Helsingfors, 1908.

Publishers forwarding books for review will greatly oblige by marking the price *in clear figures, especially in the case of foreign books.*

NEW MAPS

EUROPE.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 30th September 1908:—One-inch Map. Third edition, engraved, with hills in brown or black. Sheets 56, 57A, 66, 71, 72, 73. Price 1s. 6d. each.

Six-inch and Larger Scale Maps. Six-inch Maps (Revised) full sheets, heliozincographed, without contours. *Caithness.*—Sheet 22. Price 2s. 6d. Quarter Sheets, with contours (Price 1s. each). *Berwickshire.*—4 NW.; 4 NE.; (5 NE. and 6 NW.); 19 NW.; 19 NE.; 20 NW. *Edinburghshire.*—6 NE.; 7 SE.; 9 SE.; 23 NE. *Haddingtonshire.*—4 SW.; 5 NW.; 7 SE.; 9 NW.; 10 NE.; 12 SE.; 14 SE.; 15 SW.; 16 SW.; (19 NE. and 19 SE.).

1 : 2500 Scale Maps (revised), with Houses stippled, and with Areas. Price 3s. each. *Ayrshire.*—Sheets LXII. 9, 10; LXXIII. 7. *Kirkcudbrightshire.*—Sheets XXIII. 15, 16: XXXI. 4; XXXII. 9, 13; XXXIX. 15. *Wigtownshire*—Sheets III. 9, 10, 13, 14, 15, 16; IV. 4, 8 (11 and 7), 12, 15, 16; V. 5 (6 and 2), 7, 9, 10, 11, 12, 13, 14, 16; (V. 15 and XI. 3); VIII. 2, 4, 6, 7, 10, 11, 12, 13, 14; IX. 9, 13; X. 4, 8, 12, 16; XI. 1, 2, 4, 5, 6, 8, 9, 10, 12, 13, 14, 16; XII. 4, 5, 8, 9, 12, 13, 16; XIII. 1, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16; XIV. 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16; XV. 1, 9, 10, 13, 15; XVII. 1, 2, 7, 8, 11, 12; XVIII. 1, 4; XIX. 1, 2, 3, 4; XX. 1, 2, 3, 6, 7, 10, 11, 14, 15; XXI. 1, 5, 6; XXII. 11; XXV. 2, 3, 4; XXXII. 9; XXXV. 2, 4.

Note.—There is no coloured edition of these Sheets, and the unrevised impressions are withdrawn from sale.

ORDNANCE SURVEY OF SCOTLAND.—The following publications were issued from 1st to 31st October 1908:—Two Mile Map, printed in colours and folded in cover, or flat in sheets. *Wigtown.*—Sheet 33. Price—on paper, 1s. 6d.; mounted on linen, 2s.; mounted in sections, 2s. 6d.

Six-inch and larger Scale Maps. Six-inch Maps (revised) full sheets, without contours. *Caithness.*—Sheet 42. Price 2s. 6d. Quarter Sheets, with contours. Price 1s. each. *Berwickshire.*—5 NW.; 5 SE.; 8 NE. *Haddingtonshire.*—2 SE.; 11 SE.; 17 SW.

1 : 2500 Scale Maps (revised), with Houses stippled, and with Areas. Price 3s. each. *Ayrshire.*—Sheets LXXII. 2, 6. *Kirkcudbrightshire.*—Sheets XXIII. 2, 3, 4, 6, 7, 8, 11; XXXI. 8; XXXII. 1, 3, 5, 6, 8; XXXIX. 4, 11, 12; XL. 10; XLVI. 8; XLVII. 2, 3, 6, 7, 8, 12, 13, 15; XLVIII. 3; LIII. 2, 3, 4, 8; LIV. 1, 2, 3, 5, 10, 12, 14, 16; LVII. 2, 8. *Wigtownshire.*—Sheets III. 6, 7, 11; V. 1, 8, 15, 16; IX. 5; XI. (15 and 11); XIV. 14; XV. 5, 11, 14; XVII. 3, 4; XX. 4, 8, 12, 16; XXI. 2, 3, 8, 9, 10, 11, 13, 14, 15; XXVI. 1, 2, 3.

TURKEY.—War Office Map. Scale 1 : 250,000, or about four miles to an inch. 1908. Sheets—Gallipoli, Mount Athos, Salonika. Price 2s. 6d. each sheet.
Topographical Section, General Staff, London.

ASIA.

ARMENIA.—A Geographical Map of Armenia and its Border Ranges, with Indications of Minerals and Mineral Springs. Drawn and hand-coloured by Felix Oswald, D.Sc., F.G.S. Scale 1 : 1,013,760, or sixteen miles to an inch. 1907.
Dulau and Co., London.

This map is an important contribution to the geological surveys of Asia Minor. It obviously represents much research and painstaking labour on the part of the

author. A handbook of "Explanatory Notes," describing the various formations, accompanies the map.

PERSIAN GULF and adjacent countries.— War Office Map on scale of 1 : 4,055,040, or 64 miles to an inch. 1908. Price 1s. 6d.

Topographical Section, General Staff, London.

CHINESE EMPIRE.—Mission Atlas containing separate maps of the eighteen provinces of China Proper, on scale of 1 : 3,000,000, and of the four great dependencies on scale of 1 : 7,500,000 ; together with an Index to all the names on the maps, and a list of all Protestant Mission Stations. Specially prepared by Mr. Edward Stanford for the China Inland Mission. 1908. Price 10s. 6d.

The China Inland Mission, and Morgan and Scott, Limited, London.

This atlas is an entirely new work prepared from the latest authentic surveys. The spelling of names is according to the system adopted by the Chinese Postal Service. The maps are beautifully clear and legible, but the entire omission of any representation of hills is a considerable defect. Whilst primarily designed as a Mission Atlas the work will be sure to prove of value to all interested in the great Chinese Empire.

AFRICA.

ABYSSINIA.—Map compiled and lithographed at the War Office. Scale 1 : 3,000,000 or 1·014 inches to 48 miles. 1908. Price 2s. 6d.

Topographical Section, General Staff, London.

This is a very pretty general map of Abyssinia with graded contour colouring to show elevation.

CAMEROONS.—Map prepared at the Ordnance Survey Office. Scale 1 : 2,000,000 or 1·014 inches to 32 miles. 1908. Price 1s. 6d.

Topographical Section, General Staff, London.

GOLD COAST.—Map published by the authority of Sir John P. Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1 : 125,000 or about two miles to an inch. Sheets 72 I-IV., Dadiaso ; 72 J-III., Asafo ; 72 J-IV., Wiawoso ; 72 P-III. and 72 V-I., Tanoso and Beyin. 1908. Price 2s. each sheet.

W. and A. K. Johnston, Ltd., Edinburgh and London.

AMERICA.

DOMINION OF CANADA.—Railway map by James White, F.R.G.S., Geographer. Scale 1 : 6,336,000 or 100 miles to an inch. 1908.

Department of the Interior, Ottawa.

ONTARIO.—Department of Militia and Defence, 1908. Topographic Map. Scale 1 : 63,360 or 1 mile to an inch. Contour lines at intervals of 25 feet. No. 14, Ottawa Sheet. No. 15, Kemptville Sheet.

Topographical Section, General Staff, London.

ONTARIO AND QUEBEC.—Standard Topographic Map. Scale 1 : 250,000 or about four miles to an inch. Timiskaming Sheet, 9 NW. James White, F.R.G.S., Geographer. 1908. *Department of the Interior, Ottawa.*

UNITED STATES SURVEY.—Topographic sheets on scale of 1 : 62,500 or about one mile to an inch. 1908. Price 5 cents. each sheet. The figures after the name of each State indicate the number of sheets received. Illinois, 3 ; Iowa, 1 ; Kentucky, 1 ; Maryland, 2 ; Michigan, 1 ; Minnesota, 1 ; New York, 1 ; Ohio, 5 ; Pennsylvania, 3 ; Tennessee, 1 ; Virginia, 1 ; West Virginia, 3.

Topographic Sheets on scale of 1 : 125,000 or about two miles to an inch. 1908. California, 1 ; Missouri, 1 ; Oregon, 1 ; Texas, 1.

United States Geological Survey, Washington, D.C.

CENTRAL AMERICA.—War Office Map on scale of 1 : 1,705,000 or 27 miles to an inch. Hills in brown. Provinces shown. 1907. Price 2s.

Topographical Section, General Staff, London.

SOUTH AMERICA.—Commercial Map by J. G. Bartholomew, F.R.G.S. Scale 1 : 10,000,000. With inset maps of Rio Janeiro, Buenos Ayres, Monte Video, Valparaiso, and Lima. 1908. Price 2s., or mounted on cloth 3s.

John Bartholomew and Co., Edinburgh.

This is a new edition of this standard map revised to show the latest railways and settlements.

GENERAL.

L'ANNÉE CARTOGRAPHIQUE.—Dix-huitieme Année, 1908. Dressé et rédigé sous la direction de Fr. Schrader. Price 3 francs.

Librairie Hachette et Cie., Paris.

Monsieur Schrader's cartographic annual has now become quite an indispensable publication, and the present number is of special interest. In Africa we have records of recent surveys in the Southern Sahara, in Morocco, in the French Congo, and in Liberia. In Asia we have the new frontiers of Siam, the new railway projects in the Near East, and the results of the Khatanga Expedition in Siberia. For South America there are maps of the new frontiers and expeditions in Bolivia and Brazil.

THE CLASS-ROOM ATLAS of Physical, Political, Biblical, and Classical Geography. Edited by Edward F. Elton, M.A. Third edition, revised. Price 5s.

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ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

REPORT OF COUNCIL.

TWENTY-FOURTH SESSION, 1907-1908.

The Council has the honour to submit the following Report:—

ORDINARY MEMBERSHIP.

The changes which occurred during the Session in the number of members were as follows:—

Number on 1st November 1907,		1773
New members added,		107
		1880
Deduct by Death,	28	
„ Resignation,	143	
		171
Number of ordinary members remaining on Roll on 31st October 1908,		1709

Of this number, 968 are on the Edinburgh list, 370 are on the Glasgow list, 135 and 93 are on the Dundee and Aberdeen lists respectively. In addition to those on the lists named, 45 members reside abroad, and 98 reside in England. Of the total number of 1709 members, 249 are life members.

TEACHER ASSOCIATE MEMBERS.

Number on 1st November 1907,	22
New members added,	16
	38
Deduct by Resignations 4,	34

The Society's Anniversary Meeting was addressed by The Right Hon. Viscount Milner, P.C., G.C.B., G.C.M.G. Thirty-five ordinary meetings were held, ten in Edinburgh, nine in Glasgow, eight in Dundee, and eight in Aberdeen. These meetings were addressed by Lieut. Boyd Alexander, F.R.G.S., Mrs. Fanny Bullock Workman, F.R.S.G.S., William C. Smith, K.C., Sir Charles Bruce, G.C.M.G., J.P., D.L., G. G. Chisholm, M.A., B.Sc. (Edin.), A. Watt, M.A. (Edin.), F.R.S.E., Miss Mary Hall, L. S. Amery, The Right Hon. Sir Herbert E. Maxwell, Bart., LL.D., F.R.S., Prof. J. W. Gregory, D.Sc., F.R.S., F.G.S., and R. N. Rudmose Brown, B.Sc.

MEDALS AWARDED.

The Livingstone Gold Medal of the Society for 1907 was awarded to the Right Hon. Viscount Milner, P.C., G.C.B., G.C.M.G., in recognition of his distinguished services towards the development of Africa.

The Society's Silver Medal for 1907 was awarded to George G. Chisholm, M.A., B.Sc. (Edin.), for distinguished services to Geographical Science.

THE SOCIETY'S MAGAZINE.

The *Scottish Geographical Magazine* has, as usual, been published throughout the past session monthly, with maps and illustrations.

The Council is glad to acknowledge its obligation to the contributors of articles,

and to the following gentlemen who have rendered valuable assistance to the editors :— J. G. Bartholomew ; H. M. Cadell ; S. H. F. Capenny ; C. G. Cash ; G. G. Chisholm ; A. L. Cross ; Dr. A. S. Cumming ; H. B. Finlay ; Professor James Geikie ; Prof. C. G. Knott ; John Laidlaw ; Rev. Robert Mackenzie ; J. R. Reid ; Ralph Richardson ; R. N. Rudmose Brown ; Kenneth Sanderson ; Dr. Shand ; Dr. George Smith ; Wm. C. Smith ; Professor W. G. Smith ; C. W. A. Tait ; W. A. Taylor ; Prof. J. A. Thomson ; Andrew Watt ; Dr. Wigner ; W. B. Wilson.

Society's New Rooms.

The Council congratulates the Society on the transfer of its rooms to the handsome and commodious buildings in Castle Terrace. The new rooms are more accessible to the majority of the members, and being much more spacious, they afford ample convenience for the purposes of reading or consulting books, maps, etc. The Council sincerely hopes that members and the public will freely take advantage of the exceptional facilities for study which these new rooms afford.

Government Grant.

The efforts of the Society to extend geographical education in Scotland have been recognised by a grant from the Treasury of £200 a year.

Library and Map Department.

During the past session 239 books, 89 pamphlets, 117 reports, 10 atlases, 279 map-sheets and charts have been added to the Library. The number of volumes borrowed by members was 1614, and the Library was, as usual, much consulted by non-members in search of geographical information.

The Council desires to record its thanks to foreign and colonial governments for the official publications they have presented to the Library ; to the Treasury, for the revised Ordnance Survey Maps of Scotland, both in outline and colour, as each of the revisions now in progress is published.

Opening of Rooms in the Evening.

On the representation of a number of Ordinary Members of the Society and Teacher Associates, the Council has sanctioned provisionally the opening of the Rooms in Edinburgh on Wednesday evenings from 7 to 9.

Glasgow Centre.

Members of the Glasgow Centre will again have the advantage of the arrangement made with the Royal Philosophical Society of Glasgow, whereby that Society's very complete Library at 207 Bath Street, Glasgow, will be available to them without extra payment.

Members desirous of exercising this privilege must exhibit their Membership Cards for the current Session to the Librarian at 207 Bath Street, in order that their names may be registered, and they must conform generally to such regulations as may from time to time be laid down by the Royal Philosophical Society.

The private room at 207 Bath Street, presently rented, has been retained for the exclusive use of Members of the Glasgow Centre.

Glasgow, Dundee, and Aberdeen Centres.

The Council has again the pleasure to acknowledge the services rendered by the honorary officials of the Glasgow, Dundee, and Aberdeen Centres for their continued successful conduct of the business of the Society.

Finance.

The Council begs to submit the Annual Financial Statement.

ABSTRACT OF THE ACCOUNTS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY

From 31st October 1907 *to 31st October* 1908.

FUNDS AT CLOSE OF LAST ACCOUNT:—			
£1000 Glasgow and South-Western Railway Company 4 per cent. Funded Debt, at cost price, as at 29th May 1885,		£1102 19 9	
£533, 6s. 8d. North British Railway Company 3 per cent. Consolidated Lien Stock, at cost price, as at 30th December 1890,		496 2 0	
£200 Great Central Railway Company 4½ per cent. Debenture Stock, at cost price, as at 31st December 1898,		312 2 9	
£240 North British Railway Company 4 per cent. Consolidated Preference Stock, at cost price, as at 11th December 1902,		306 8 9	
		£2217 13 3	
BALANCES due by Bank of Scotland—			
1. On Account Current,	£153 7 7		
2. On Deposit Receipt,	4 19 5		
3. Do. do. (Glasgow Equipment Fund)	57 9 7		
		215 16 7	
BALANCE due by Secretary, 9s. 7d., and Glasgow Secretary, £1, 12s.,		2 1 7	
PAYMENTS in connection with "Chair of Geography" (recoverable).		6 12 6	
		£2442 3 11	
Less—			
Balance due to Livingstone Fund,	£27 10 6		
Account outstanding,	40 15 6		
		68 6 0	
		£2373 17 11	
SUBSCRIPTIONS from Ordinary Members,	£1404 17 0		
Do. do. Associate Members,	14 14 0		
FEES received for Society's Diploma,	14 14 0		
DIVIDENDS and INTEREST,	77 14 3		
		1511 19 3	
MISCELLANEOUS,		6 0 0	
		£3891 17 2	

MAGAZINE—Expenses of Publication, etc., for Nos. 11 and 12 of Vol. XXIII., and Nos. 1 to 10 of Vol. XXIV.:—			
Printing and other charges,			£535 18 3
Illustrations, £27 5 9 | Maps,	£36 2 6		63 8 3
			£599 6 6
Less—			
Magazines sold,	£59 7 6		
Advertising Receipts, less Payments,	67 18 5		
		127 5 11	
		£472 0 7	
GENERAL PRINTING,			51 15 11
BOOKS and other furnishings for Library,			32 9 4
RENT OF HALL, and other expenses of Lectures,	£490 18 2		
Less Lecture Tickets sold,	93 16 0		
		397 2 2	
GLASGOW BRANCH, Rent of Hall,			25 0 0
RENT OF COUNCIL ROOM, Taxes, Gas, Repairs, Insurance, etc.,			130 17 7
SALARIES,			499 17 6
MISCELLANEOUS, including Stationery, General Expenses, and Postages,			113 17 2
MEDALS,			2 0 0
		£1725 0 3	
FUNDS AT CLOSE OF THIS ACCOUNT:—			
£1000 Glasgow and South-Western Railway Company 4 per cent. Funded Debt, at cost price, as at 29th May 1885,		£1102 19 9	
£533, 6s. 8d. North British Railway Company 3 per cent. Consolidated Lien Stock, at cost price, as at 30th December 1890,		496 2 0	
£200 Great Central Railway Company 4½ per cent. Debenture Stock, at cost price, as at 31st December 1898,		312 2 9	
£240 North British Railway Company 4 per cent. Consolidated Preference Stock, at cost price, as at 11th December 1902,		306 8 9	
		£2217 13 3	
BALANCES due by the Bank of Scotland:—			
1. On Deposit Receipt,	£4 19 5		
2. On do. do. (Glasgow Equipment Fund),	59 3 3		
		64 2 8	
BALANCE due by Secretary, £9, 19s. 9d., and Glasgow Secretary, 7s. 6d.,		10 7 3	
PAYMENTS in connection with "Chair of Geography" (recoverable),		10 10 6	
		£2302 13 8	
Less—			
BALANCE due to Livingstone Fund,	£26 19 10		
Do. do., Bank of Scotland,	108 16 11		
		135 16 9	
		2166 16 11	
		£3891 17 2	

Edinburgh, 12th November 1908.—We have examined the Accounts of the Royal Scottish Geographical Society for the year ending 31st October 1908, of which the above is an Abstract, and compared them with the Vouchers and Instructions thereof, and find the same correct and sufficiently vouched. MACANDREW & BLAIR, C.A.

LIVINGSTONE MEDAL FUND.

FUNDS AT CLOSE OF LAST ACCOUNT:—		
£770 North British Railway Company 4 per cent. Preference Stock No. 1, at cost price,	£999 11 6	
Balance due by General Fund,	27 10 6	
	£1027 2 0	
Income received—		
Dividend on £770 North British Railway Company 4 per cent. Preference Stock No. 1—		
For half-year to 31st January 1908, £15, 8s., less tax, 15s. 4d.,	£14 12 8	
For half-year to 31st July 1908, £15, 8s., less tax, 15s. 4d.,	14 12 8	
	29 5 4	
	£1056 7 4	

Paid Messrs. Alex. Kirkwood and Son for Medal,		£29 16 0
Funds at close of this Account		
£770 North British Railway Company 4 per cent. Preference Stock No. 1, at cost price,	£999 11 6	
Balance due by General Fund	26 19 10	
	1026 11 4	
	£1056 7 4	

Edinburgh, 12th November 1908.—Examined and found correct.—MACANDREW & BLAIR, C.A.

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